FINAL REPORT
YANKEE MINE SITE
UTAH COUNTY, UTAH
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1.0 INTRODUCTION

1.1 Objective of Study

The objective of this project was to conduct an extent of contamination investigation at the Yankee Mine, Globe Mine, Scotchman, and Plume L-94 mine tailings sites located in the Utah County, Utah. The investigation used field screening methodologies [X-Ray Fluorescence (XRF)] to assess metal contaminant levels (e.g., lead, zinc, and arsenic) in surface and subsurface soils on and surrounding the tailings pile associated with the sites' past mining operations. Surface water samples were collected from Mary Ellen Gulch and from observed groundwater discharges (e.g., seeps and springs) or mine discharges.

1.2 Site Description and Background

The Yankee Mine site is located in central Utah in the Uinta National Forest, approximately 25 miles east of Orem, Utah (Figure 1). The site is located on the southern side of the Wasatch Mountain Range between Twin Peaks and Mount Baldy at elevations ranging from 7,700 to 9,500 feet. The area is rural with very limited access by dirt roads or trails. The Yankee Mine, Globe Mine, and Plume L-94 are located near the headwaters of Mary Ellen Gulch. The Scotchman site is located further down the valley, adjacent to the American Fork Stream. Numerous mining operations utilized the area until the early to mid-1900s. Residual tailings piles from these mining operations are located throughout the American Fork Canyon watershed. Previous analytical results from the sampling of other tailing piles in the area have indicated the presence of heavy metals (including lead, arsenic, and zinc). In an effort to minimize the impact on public health and the environment posed by contaminants in the tailings, a Federal project is planned to select a nearby location to be used as a repository for the mine tailings from selected sites.

The United States Environmental Protection Agency/Environmental Response Team Center (U.S. EPA/ERTC) has been requested by the U.S. EPA Region VIII On Scene Coordinator (OSC) to perform a field investigation to meet the above objectives. Response Engineering and Analytical Contract (REAC) personnel conducted this investigation utilizing the technical approach described below.

2.0 METHODOLOGY

2.1 Surface Water Sampling

A total of fourteen surface water samples were collected from Mary Ellen Gulch, springs, seeps, and mine drainages observed on the site. When sufficient water was present, surface water samples were collected directly into appropriately labeled sample containers. Where low levels of water were present, surface water was transferred to a sample container using a dedicated plastic scoop. All sampling was performed per ERT/REAC Standard Operating Procedure (SOP) #2013, *Surface Water Sampling* and all site activities were documented in a site log book (Appendix A). Water samples were preserved by adding 40 percent nitric acid (trace metal grade) until the pH was below 2. Water samples for Target Analyte List (TAL) metals were maintained and shipped to the REAC Laboratories in Edison, NJ for TAL metal analysis on wet ice at approximately 4 degrees Celsius (°C)

At each sample location, water quality parameters (pH, conductivity, dissolved oxygen, and temperature) were collected using a Horiba U10 Water Quality Analyzer. Data were recorded in the site log book.

2.2 Soil Sampling

A total of ninety eight surface and seven subsurface soil samples were collected to evaluate the extent of contamination. Surface soil samples were collected from the upper 4-inches of soil using a dedicated stainless steel spoon or plastic scoop. Samples were placed in an 8-ounce glass jar or a self-sealing plastic bag, transported to the staging area, and thoroughly homogenized. After mixing, aliquots were taken for XRF analysis. For confirmation of the field screening analysis, 28 XRF cups (29 percent) were submitted to the REAC Laboratory for TAL metal analyses using graphite furnace atomic absorption (GFAA) and inductively-coupled plasma (ICP).

Subsurface samples were collected at three locations to evaluate the depth of the tailings and the extent of contamination. The intention was to collect samples at 1-foot intervals to a depth of 6-feet below ground surface (bgs), but refusal was encountered at much shallower depths (1 to 4 feet bgs) in all cases. Subsurface samples were collected using a bucket auger to dig to the specified depth, then a second decontaminated bucket auger was used to collect the sample. The sample material was transferred from the bucket auger to an 8-ounce glass jar and transported to the staging area for XRF analysis. Confirmation samples were shipped on wet ice at a temperature of approximately 4° C to the REAC Laboratory for TAL metal analysis.

2.3 X-Ray Fluorescence Analysis

All soil samples were screened in the field for zinc, arsenic and lead using a Spectrace 9000 field portable XRF analyzer (Appendix B). Samples were prepared by sieving homogenized soil through a 20-mesh sieve and transferring the sieved soil to XRF cups. XRF analysis was conducted in accordance with ERT/REAC SOP #1713, *Spectrace 9000 Field Portable X-Ray Fluorescence Operating Procedure*. Field screening data was provided to the U.S. EPA/ERTC Work Assignment Manager (WAM) daily, and this data was used to select additional sampling areas.

Regression analysis was used to compare XRF and laboratory confirmation data as specified in the U.S. EPA/ERTC Quality Assurance Technical Bulletin. If there is a significant relationship [coefficient of determination (r^2) $\geq$ 0.70] between XRF and laboratory confirmation data, the XRF data will be considered Quality Assurance Level 2 (QA2) data. If a significant relationship does not exist ($r^2 < 0.70$), the data will be considered Quality Assurance Level 1 (QA1) or screening data.

2.4 Site Maps

During this site investigation, all sample locations and site features (including Mary Ellen Gulch and its tributaries) were mapped using a Trimble PRO-XRS real-time differential Global Positioning System (GPS) equipment. The accuracy of the GPS varies depending on field conditions, but is typically accurate to within 1 to 5 meters. These data were used

to construct maps of site features and sample locations and were also overlaid on United States Geological Survey (USGS) 1-meter digital ortho-corrected aerial photographs.

2.5 Standard Operating Procedures

Documentation was conducted in accordance with the following standard operating procedures (SOPs):

REAC SOP #2002, *Sample Documentation*
REAC SOP #4001, *Logbook Documentation*
REAC SOP #4005, *Chain of Custody Procedures*

Sample packaging, packaging, shipment, storage, preservation, and handling were conducted in accordance with the following SOPs:

REAC SOP #2003, *Sample Storage, Preservation, and Handling*
REAC SOP #2004, *Sample Packaging and Shipment*

Field sampling and on-site analytical techniques were conducted in accordance with the following SOPs:

ERT/REAC SOP #1713, *Spectrace 9000 Field Portable X-Ray Fluorescence Operating Procedure*
ERT/REAC SOP #2001, *General Field Sampling Guidelines*
ERT/REAC SOP #2005, *Quality Assurance/Quality Control Samples*
ERT/REAC SOP #2006, *Sampling Equipment Decontamination*
ERT/REAC SOP #2012, *Soil Sampling*
ERT/REAC SOP #2013, *Surface Water Sampling*

3.0 RESULTS AND DISCUSSION

All soil samples collected were screened for lead (Pb), arsenic (As), and zinc (Zn) in the field by XRF (Table 1 for surface soil data, Table 2 for subsurface soil data and Appendix B for the XRF Final Report). Twenty-eight of these soil samples (25 locations and 3 duplicate samples) were submitted for TAL metals confirmation analysis (Table 3). Samples selected for confirmation analysis included a full range of contaminant concentrations. Fifteen surface water samples were collected (14 samples and 1 duplicate sample) and analyzed for TAL metals. The results in micrograms per liter (µg/L) are summarized in Table 5.

For all inorganic laboratory data, metal concentrations below the method detection limit (MDL) were reported on the tables as not detected (ND). Appendices B (XRF Final Report) and C (Final Analytical Report), contain the supporting analytical reports, which provide a complete summary of all results, detection limits, and methods.

3.1 XRF Field Screening

As summarized in Table 4, XRF performed well as a screening tool for quantifying arsenic and zinc across the entire concentration gradient and lead at concentrations below 10,000

milligrams per kilogram (mg/kg). The coefficient of determination (r^2) between XRF and laboratory confirmation data exceeded 0.70 for both As ($r^2 = 0.73$) and Zn ($r^2 = 0.96$), indicating that the XRF data is considered QA-2 level data. Using all data points, there was a poor correlation for Pb between laboratory and XRF data ($r^2 = 0.45$). This appeared to be a result of low XRF response for concentrations exceeding 10,000 mg/kg. If all data points exceeding 10,000 mg/kg for Pb were excluded in the regression analysis, a higher coefficient of determination ($r^2 = 0.71$) was attained. Therefore, samples with XRF Pb concentrations below 10,000 mg/kg are considered to be QA2 level data, while samples with XRF Pb concentrations above 10,000 mg/kg are considered to be QA1 level data (screening data).

All samples with XRF Pb concentrations greater than 10,000 mg/kg are expected to have higher Pb concentrations than quantified by XRF. The x-coefficients in the regression analyses show that the XRF data underestimated metal concentrations compared to the laboratory analyses. X-coefficients were 1.2 for As, 2.0 for Pb and 2.1 for Zn. Multiplying the x-coefficient by the XRF concentration would provide a more comparable concentration to the fixed laboratory based data. The XRF MDLs for Zn, As, and Pb were 102 mg/kg, 72 mg/kg, and 41 mg/kg, respectively. Due to the Pb to As ratio, As concentrations were not quantified below one-tenth of the Pb concentration.

When evaluating this data, the inaccuracy of XRF lead data in samples at concentrations above 10,000 mg/kg must be emphasized. The highest Pb concentration quantified by XRF was 18,000 mg/kg, whereas this sample quantified by the laboratory analysis was 41,000 mg/kg. Ten of the 28 samples submitted for confirmation had Pb concentrations exceeding 18,000 mg/kg with the highest concentration being 95,000 mg/kg at location 61 (Table 4). Although the XRF provided accurate data for samples below 10,000 mg/kg of Pb, it was not able to accurately quantify Pb concentrations in samples exceeding 10,000 mg/kg.

It should also be noted that there is a moderate interference between As and Pb on the XRF. Arsenic will not be detected at concentrations below one-tenth of the Pb concentration in the sample. For example, if Pb was detected at 16,000 mg/kg in a sample, As would only be quantified if the concentration exceeded 1,600 mg/kg. This interference caused As to appear to be detected less frequently (i.e., more non-detects) then it may actually occur at the site. In the samples sent to the fixed laboratory for confirmation analysis, As was reported as not detected by XRF in 14 of the 28 samples. These same samples analyzed in the laboratory had As concentrations ranging from 120 mg/kg to 680 mg/kg with an average concentration of 384 mg/kg.

3.2 Surface Water

Samples SW-1, SW-7, SW-9, SW-10, and SW-12 were collected directly from Mary Ellen Gulch (Figure 2). Sample SW-11 was collected from an unnamed gulch that drains the northeastern portion of the valley and is not impacted by the Yankee Mine, Globe Mine and Plume L-94 tailings piles. This unnamed gulch joins Mary Ellen Gulch down gradient of the tailings pile and between locations SW-10 and SW-12. Samples SW-2, SW-3, SW-4, SW-5, and SW-6 were collected from or immediately downstream of spring or mine discharges along a hillside that was historically mined. SW-2 was collected from a spring discharge up gradient of the southern Yankee Mine tailings pile. The spring had a flow of

about 5 gallons per minute (gpm) and ran down the hillside for a short distance before flowing into the tailings. SW-3 was collected from a spring discharge with a flow of less then 0.5 gpm. The water discharged from the spring flowed across the ground and into a small bermed pond on top of the tailings pile. The actual sample was collected from a small pool of water between the spring and the pond. Sample SW-4 was collected from a small pool between the mine adit and the pond, formed by discharges from a mine adit with a flow rate of less then 0.5 gpm. The water traveled across the ground and into the same bermed pond where sample SW-3 was taken. The berm on the pond was breached on the south side and water from the pond flowed through the breach and onto the tailings pile. Samples SW-5 and SW-6 were both collected from spring discharges near the east edge of the Yankee Mine (north) tailings pile. The spring discharge where sample SW-5 was taken was greater then 5 gpm while the discharge where SW-6 was taken was less then 0.5 gpm. Water from both of these springs flowed across the tailings/access road and formed three separate drainage pathways before flowing over the edge of the slope and joining Mary Ellen Gulch. SW-8 was collected from one of these drainage pathways just before its confluence with Mary Ellen Gulch. Seep-1 and Seep-2 were collected from two seeps located between the southern extent of the Yankee Mine tailings pile and Mary Ellen Gulch. Both had flow rates below 1 gpm and water from the seeps flowed a short distance on the ground before discharging into Mary Ellen Gulch. Sample locations are indicated on Figure 2 and water quality data are summarized in Tables 5 (dissolved surface water metal concentrations) and 6 (other surface water quality parameters).

The upstream reference sample contained As, Pb, and mercury (Hg) at concentrations below the analytical MDLs and copper (Cu) and Zn at 44 micrograms per liter (μg/L) each. Sample SW-11 contained As, Pb, Hg, Cu, and Zn at concentrations below the analytical MDLs.

With the exception of SW-5, all seeps and mine discharges (SW-2, SW-3, SW-4, SW-6) up gradient of the Yankee Mine tailings pile contained metal concentrations near or below concentrations found at the reference location (Figure 3). The sample collected at SW-5 contained elevated levels, compared to the reference location, of Zn (290 μg/L) and As (83 μg/L). Water from these discharges, with the exception of SW-5, did not seem to contribute a significant source of metal contamination to Mary Ellen Gulch.

The source of the water for SW-8 was the same as the source for SW-5 and SW-6, but SW-8 was collected approximately 150 feet further downstream, after the water flowed across the parking lot (tailings) and down most of the face of the tailings pile, but immediately before its confluence with Mary Ellen Gulch. SW-8 had much higher levels of As (920 μg/L), Cu (110 μg/L), Pb (230 μg/L), and Zn (820 μg/L) than either SW-5 or SW-6. This suggests that significant quantities of metals are dissolved in the surface water, after traveling over this portion of the tailings pile.

Samples collected from SEEP-1 and SEEP-2 contained greater than 10 times the levels of Zn (670 μg/L and 770 μg/L, respectively) compared to the reference sample (SW-1). Most likely these seeps travel (at least part of the way) through the tailings before discharging down gradient of the tailings pile.

Five surface water samples (SW-1, SW-7, SW-9, SW-10, and SW-12) were collected directly from Mary Ellen Gulch. The reference sample, SW-1, was collected upstream and up gradient of the Globe tailings pile. The next sample, SW-7 was collected downstream of the Globe Mine tailings, but upstream of the Yankee Mine tailings. Three more samples were collected from Mary Ellen Gulch: SW-12 was immediately up gradient of the confluence of Mary Ellen Gulch and an unnamed Gulch, SW10 was collected down gradient of the confluence, and SW-9 was collected furthest downstream and immediately upstream of the split in the gulch. The samples collected further downstream were impacted by an increased number of surface and subsurface drainage flows that came in contact with the tailings. As shown in Figure 4, there was an increasing trend in metal concentrations in Mary Ellen Gulch.

3.3 Soil Samples

Elevated concentrations of Zn and Pb were associated with most samples collected on and adjacent to the Yankee Mine, Globe Mine, Plume L-94, and Scotchman tailings piles (Table 1, 2, and 3 and Figure 5). The discussion below compares XRF data between locations (only XRF data was collected at all sample locations).

Overall there were no patterns or trends in metal concentrations within each tailings pile (Figure 6, 7, and 8). Metal concentrations in each tailings pile were highly variable. Table 7 contains a summary of mean ($\bar{x}$) concentrations for Zn, As, and Pb in each of the tailings piles. The highest average concentration of Zn ($\bar{x}$ = 4,328 mg/kg) were taken in the L-94 tailings pile, As ($\bar{x}$ = 194 mg/kg) in the Yankee Mine (north) tailings pile, and Pb ($\bar{x}$ = 3,543 mg/kg) in the Globe tailings pile. The standard errors indicate the high degree of variability within each pile. Several additional soil samples were taken from the tailings pile. Four samples (87, 88, 89, 90) were collected below a bermed pond down gradient of the Yankee (south) tailings pile. The berm appeared to be constructed from tailings and there was a breach in the center of it, allowing water to overflow at high water levels. These samples contained levels of Zn ranging from 1,900 mg/kg to 21,000 mg/kg and Pb ranging from 3,600 mg/kg to 4,800 mg/kg. Arsenic was not detected in any of these samples. Nine soil samples (31, 32, 51 through 56, and 94) were collected off the tailings pile adjacent to Mary Ellen Gulch. These samples contained Zn levels ranging from 420 mg/kg to 3,200 mg/kg, As concentrations ranging from not detected (ND) to 950 mg/kg (second highest As concentration of all samples collected on the site), and Pb concentrations ranging from 230 mg/kg to 9,100 mg/kg. Location 52 (Zn = 2,200 mg/kg, Pb = 2,500 mg/kg) appeared to have been used as a campsite.

Subsurface samples were collected at three locations, but depths of sample collection was limited due to refusal (Table 2). Between the three locations, there were no overall patterns of contamination relative to depth. At location 9, the highest Zn and Pb concentrations were detected at a depth of 2 feet bgs and the highest As concentration was detected at a depth of 1 foot bgs. At locations 11 and 96, the highest Zn and Pb concentrations were detected at the surface and the highest As concentration was detected at a depth of 1-foot.

4.0 CONCLUSIONS

Lead, arsenic, and zinc were detected at concentrations up to 95,000 mg/kg (based on laboratory confirmation data), 16,000 mg/kg (based on XRF data), and 59,000 mg/kg (based on laboratory confirmation data), respectively, in the tailings and soil samples collected at the site. The contamination wasn't limited to specific portions of the site but was widespread both on and off the tailings piles. Several samples collected off of the tailings piles adjacent to Mary Ellen Gulch (including one location which appeared to be used as a camp site) contained elevated Pb concentrations (up to 21,000 mg/kg based on confirmation data), Zn (up to 6,700 mg/kg based on confirmation data), and As (up to 950 mg/kg based on XRF data). When comparing tailings piles, plume L-94 had the highest average Zn concentration ($\bar{x}$ = 4,328 mg/kg), Yankee Mine (north) had the highest average As concentration ($\bar{x}$ = 194 mg/kg), and Globe Mine had the highest average Pb concentration ($\bar{x}$ = 3,543 mg/kg).

Five of the six springs/mine discharges sampled up gradient of the Yankee Mine tailing piles had comparable contaminant levels to the reference sample, while SW-05 contained elevated levels of Zn and As. The water source for samples SW-8 (discharge 5 and 6) was the same as the sources for SW-5 and SW-6, but SW-8 was collected approximately 150 feet downstream after flowing over tailings. SW-8 contained much higher As, Cu, Pb, and Zn concentrations compared to SW-5 and SW-6. This provides evidence that the tailings are a source of metal contamination to the Mary Ellen Gulch. In addition, two seep samples (SEEP-1 and SEEP-2) collected down gradient of the Yankee Mine tailings pile also contained elevated levels of Zn and Cu compared to the spring samples (SW-2, SW-3, SW-4, and SW-6) collected up gradient of the tailings pile. Several surface water samples collected from Mary Ellen Gulch, starting up gradient of the Globe Mine tailings pile, indicated increasing metals concentrations after flowing down gradient across the Globe Mine tailings and again after flowing down gradient of the Yankee Mine tailings piles.

Tables

Table 1
XRF Metals in Surface Soils
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Sample	Date	Zinc	Arsenic	Lead
1	2 October 2001	630	150 J	800
1 (DUP)	2 October 2001	780	150 J	610
2	2 October 2001	5,400	240 J	4,300
2 (REP)	2 October 2001	1,900	ND	4,500
2 (DUP)	2 October 2001	1,900	ND	5,000
3	2 October 2001	530	ND	2,100
3 (DUP1)	2 October 2001	830	ND	2,200
3 (DUP2)	2 October 2001	520	ND	2,000
4	2 October 2001	4,700	ND	8,800
4 (DUP)	2 October 2001	5,400	ND	8,300
5	2 October 2001	1,800	ND	4,200
5 (DUP)	2 October 2001	1,400	ND	3,600
6	2 October 2001	890	ND	1,700
6 (DUP)	2 October 2001	1,000	ND	1,800
7	2 October 2001	2,600	ND	7,200
7 (DUP)	2 October 2001	3,000	ND	7,200
8	2 October 2001	200 J	ND	88 J
8 (DUP)	2 October 2001	200 J	ND	98 J
9	2 October 2001	420	150 J	480
9 (DUP)	2 October 2001	240 J	140 J	470
10	2 October 2001	2,800	ND	1,600
10 (DUP)	2 October 2001	2,600	180 J	1,400
11	2 October 2001	ND	ND	1,600
11 (DUP)	2 October 2001	110 J	ND	1,900
12	2 October 2001	1,800	540	520
13	2 October 2001	290 J	ND	1,100
14	2 October 2001	990	220 J	870
15	2 October 2001	600	100 J	180
16	2 October 2001	680	150 J	320
17	2 October 2001	560	ND	2,000
18	2 October 2001	7,500	ND	6,100
18 (DUP)	2 October 2001	6,800	ND	5,400
19	2 October 2001	160 J	ND	1,100
20	2 October 2001	2,100	ND	4,600
21	3 October 2001	ND	ND	260
22	3 October 2001	330 J	130 J	1,200
23	3 October 2001	1,000	350	1,700
23 (DUP)	3 October 2001	620	190 J	1,700
24	3 October 2001	510	ND	2,100
25	3 October 2001	1,100	ND	4,500
26	3 October 2001	730	ND	2,600
27	3 October 2001	1,200	ND	920
28	3 October 2001	8,800	ND	13,000
28 (DUP)	3 October 2001	11,000	ND	15,000
29	3 October 2001	28,000	ND	16,000
30	3 October 2001	1,300	370	1,600

ND = Not Detected at concentrations above the detection limit.
J = Estimated Value
mg/kg = milligrams/kilogram
ppm = parts per million

Table 1 (Cont'd)
XRF Metals in Surface Soils
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Sample	Date	Zinc	Arsenic	Lead
31	3 October 2001	790	340	2,700
32	3 October 2001	11,000	ND	14,000
33	3 October 2001	200 J	650	1,200
34	3 October 2001	680	410	2,200
35	3 October 2001	2,800	600	4,000
36	3 October 2001	3,600	ND	3,700
37	3 October 2001	1,700	350	2,200
38	3 October 2001	250 J	ND	1,400
39 (DUP)	3 October 2001	650	ND	3,800
40	3 October 2001	2,200	ND	2,600
41 (DUP)	3 October 2001	160 J	130 J	670
42	3 October 2001	120 J	ND	2,400
43	3 October 2001	130 J	170 J	690
43 (DUP)	3 October 2001	310 J	130 J	870
44	3 October 2001	310 J	1,600	410
45	3 October 2001	760	240 J	920
46	3 October 2001	170 J	ND	2,400
47	3 October 2001	130 J	ND	2,000
48	3 October 2001	600	ND	4,800
49	3 October 2001	1,600	ND	2,900
50	3 October 2001	340	87 J	80 J
51	3 October 2001	1,100	ND	1,100
51 (DUP)	3 October 2001	1,100	ND	1,100
52	3 October 2001	2,100	ND	2,600
52 (DUP)	3 October 2001	2,300	ND	2,400
53	3 October 2001	420	ND	230
53 (DUP)	3 October 2001	420	ND	280
54	3 October 2001	1,500	950	6,800
54 (DUP)	3 October 2001	2,700	810	5,500
55	3 October 2001	3,200	500	2,200
56	3 October 2001	1,700	ND	9,100
56 (DUP)	3 October 2001	1,200	ND	7,800
56 (DUP/REP)	3 October 2001	1,400	ND	7,900
57	3 October 2001	1,600	270	830
58	3 October 2001	960	100 J	480
59	3 October 2001	280 J	300	85 J
60	3 October 2001	3,800	ND	1,700
61	3 October 2001	14,000	ND	12,000
61 (DUP)	3 October 2001	15,000	ND	13,000
62	3 October 2001	820	320	120 J
63	3 October 2001	610	ND	4,700
64	3 October 2001	13,000	ND	16,000
65	3 October 2001	300 J	ND	830
66	3 October 2001	320 J	710	530
67	3 October 2001	300 J	650	290
68	3 October 2001	1,200	ND	4,400

ND = Not Detected at concentrations above the detection limit.
J = Estimated Value
mg/kg = milligrams/kilogram
ppm = parts per million

Table 1 (Cont'd)
XRF Metals in Surface Soils
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Sample	Date	Zinc	Arsenic	Lead
69	3 October 2001	870	470	160
70	3 October 2001	150 J	150 J	660
71	3 October 2001	820	ND	2,200
72	3 October 2001	660	420	1,200
73	3 October 2001	1,500	ND	630
74	3 October 2001	1,200	ND	3,300
75	3 October 2001	2,300	ND	9,800
75 (DUP)	3 October 2001	3,000	ND	11,000
76	3 October 2001	1,700	ND	4,800
77	3 October 2001	450	ND	4,900
78	3 October 2001	870	ND	4,600
79	3 October 2001	1,100	ND	4,900
80	3 October 2001	630	ND	5,600
81	3 October 2001	360	ND	3,900
82	3 October 2001	670	ND	4,000
83	3 October 2001	350	ND	1,600
84	3 October 2001	190 J	ND	2,700
85	3 October 2001	ND	ND	3,000
86	3 October 2001	140 J	120 J	900
86 (DUP)	3 October 2001	ND	ND	900
87	4 October 2001	1,100	ND	2,100
88	4 October 2001	1,500	380	430
89	4 October 2001	220 J	ND	ND
90	4 October 2001	370	87 J	210
91	4 October 2001	1,900	ND	4,500
91 (DUP)	4 October 2001	2,200	ND	4,700
92	4 October 2001	1,900	ND	3,600
93	4 October 2001	3,400	ND	4,200
93 (DUP)	4 October 2001	2,600	ND	4,000
94	4 October 2001	21,000	ND	4,800
95	4 October 2001	140 J	ND	45 J
96	4 October 2001	650	ND	1,900
97	4 October 2001	2,400	ND	8,700
98	4 October 2001	560	ND	330

ND = Not Detected at concentrations above the detection limit.
J = Estimated Value
mg/kg = milligrams/kilogram
ppm = parts per million

Table 2
XRF Metals in Subsurface Soils
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Sample	Date	Zinc	Arsenic	Lead
9	2 October 2001	420	150 J	480
9 (DUP)	2 October 2001	240 J	140 J	470
9-1'	4 October 2001	470	810	3,000
9-2'	4 October 2001	6,100	ND	18,000
9-3'	4 October 2001	5,900	ND	14,000
9-4'	4 October 2001	430	740	360
11	2 October 2001	ND	ND	1,600
11 (DUP)	2 October 2001	110 J	ND	1,900
11-1'	4 October 2001	ND	110 J	800
11-2'	4 October 2001	ND	ND	1,000
96	4 October 2001	650	ND	1,900
96-1'	4 October 2001	210 J	89 J	110 J

ND = Not Detected at concentrations above the detection limit.
J = Estimated Value
mg/kg = milligrams/kilogram
ppm = parts per million

Table 3
TAL Metals in Soils
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Location	Arsenic	Copper	Lead	Mercury	Zinc
2	650	500	11,000	14	3,400
4	430	79	16,000	47	14,000
7	490	280	20,000	4.4	5,600
10	120	340	2,600	3.7	4,700
10 (DUP)	170	220	2,300	3.2	4,700
12	360	280	560	0.64	1,500
14	290	1,100	880	0.52	1,600
18	680	470	20,000	39	11,000
20	140	15,000	4,800	2.1	1,500
23	300	700	1,700	1.7	1,300
23 (DUP)	300	680	1,800	1.1	920
25	400	2,300	3,800	1.7	1,100
28	370	330	32,000	51	23,000
29	280	340	21,000	67	59,000
32	270	310	17,000	35	21,000
35	1,200	890	5,200	4.2	4,400
44	1,500	67	340	0.26	160
50	43	50	86	0.34	240
54 (DUP)	820	760	21,000	4.8	6,700
54	820	1,500	25,000	5.4	5,100
59	230	36	95	0.15	190
61	560	3,000	95,000	3.0	29,000
64	520	3,600	23,000	32	20,000
75	160	1,600	30,000	2.1	5,700
86	81	37	930	0.3	46
97	300	550	11,000	4.7	2,600
9-2'	660	990	41,000	72	13,000
9-4'	560	170	310	0.42	360

mg/kg = milligrams/kilogram
ppm = parts per million

Table 4
Comparison of XRF and TAL Metal Concentrations
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

Location	ARSENIC		LEAD		ZINC	
	TAL	XRF	TAL	XRF	TAL	XRF
2*	650	160 J	11,000	4,400	3,400	3,700
4	430	ND	16,000	8,800	14,000	4,700
7	490	ND	20,000	7,200	5,600	2,600
10	120	ND	2,600	1,600	4,700	2,800
10 (DUP)	170	180 J	2,300	1,400	4,700	2,600
12	360	540	560	520	1,500	1,800
14	290	220 J	880	870	1,600	990
18	680	ND	20,000	6,100	11,000	7,500
20	140	ND	4,800	4,600	1,500	2,100
23	300	350	1,700	1,700	1,300	1,000
23 (DUP)	300	190 J	1,800	1,700	920	620
25	400	ND	3,800	4,500	1,100	1,100
28	370	ND	32,000	13,000	23,000	8,800
29	280	ND	21,000	16,000	59,000	28,000
32	270	ND	17,000	14,000	21,000	11,000
35	1,200	600	5,200	4,000	4,400	2,800
44	1,500	1,600	340	410	160	310 J
50	43	87 J	86	80 J	240	340
54	820	950	21,000	6,800	6,700	1,500
54 (DUP)	820	810	25,000	5,500	5,100	2,700
59	230	300	95	85 J	190	280 J
61	560	ND	95,000	12,000	29,000	14,000
64	520	ND	23,000	16,000	20,000	13,000
75	160	ND	30,000	9,800	5,700	2,300
86	81	120 J	930	900	46	140 J
97	300	ND	11,000	8,700	2,600	2,400
9-2'	660	ND	41,000	18,000	13,000	6,100
9-4'	560	740	310	360	360	430
coefficient of correlation	0.73		0.45* 0.71**		0.96	
x-coefficient	1.2		2.0		2.1	

ND = Not Detected at concentrations above the detection limit.
J = Estimated Value
mg/kg = milligrams/kilogram
ppm = parts per million
* = All Data points
** = data points < 10,000 mg/kg

Table 5
Dissolved TAL Metals in Surface Waters
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are µg/L (ppb)

Analyte	SW-01	SW-01 DUP	SW-02	SW-03	SW-04	SW-05	SW-06	SW-07	SW-08	SW-09	SW-10	SW-11	SW-12	SEEP 1	SEEP 2
Aluminum	480	480	ND	340	260	100	ND	140	3,300	1,600	560	ND	520	ND	100
Antimony	ND	ND	ND	ND	ND	2.9	ND	4.6	46	13	6.5	ND	13	2.8	ND
Arsenic	ND	ND	ND	2.8	4.0	83	ND	ND	920	98	49	ND	63	8.4	ND
Barium	23	23	61	79	24	15	78	26	67	68	36	39	32	150	66
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.4	ND	ND	ND	ND	5.0
Calcium	20,000	20,000	37,000	48,000	64,000	23,000	44,000	24,000	25,000	30,000	29,000	33,000	27,000	47,000	44,000
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	44	45	ND	ND	ND	ND	ND	12	110	140	37	ND	47	ND	63
Iron	37	39	ND	400	590	8,200	77	250	120,000	14,000	5,700	26	7,300	8,500	99
Lead	ND	ND	ND	11	12	2.9	5.2	6.0	230	180	57	ND	130	ND	11
Magnesium	7,700	7,800	19,000	25,000	33,000	8,800	15,000	9,600	9,700	12,000	11,000	11,000	11,000	23,000	22,000
Manganese	16	17	ND	25	29	140	5.2	19	200	110	79	ND	100	380	85
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.28	ND	ND	ND	ND	ND
Nickel	ND	ND	ND	ND	ND	12	ND	ND	16	12	ND	ND	ND	ND	ND
Potassium	ND	ND	ND	ND	ND	ND	ND	ND	ND	2,500	ND	ND	ND	ND	ND
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	770	750	750	820	900	880	1,400	770	900	990	870	900	850	1,100	840
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	86	ND	ND	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	44	44	26	21	34	290	58	160	820	1,000	320	ND	420	670	770

ND = Not Detected at concentrations above the detection limit.
ug/L = micrograms/Liter
ppb = parts per billion

Table 6
Surface Water Quality Paramters
Yankee Mine Site
Utah County, Utah
August 2002

Location	pH (units)	Dissolved Oxygen (mg/L)	Temperature (C)	Conductivity (mS/cm)	Estimated Flow Rate (gallons/minute)
SW-1	NA	NA	NA	NA	NA
SW-2	7.83	11.30	7.9	0.600	> 5
SW-3	8.12	7.89	13.9	0.509	< 0.5
SW-4	8.20	8.50	12.8	0.596	< 0.5
SW-5	6.72	7.85	7.2	0.228	> 5
SW-6	7.10	5.49	13.2	0.324	< 0.5
SW-7	7.65	9.29	7.1	0.203	10 - 15
SW-8	7.49	9.20	7.7	0.013	NA
SW-9	7.97	8.74	9.3	0.244	> 25
SW-10	7.95	8.86	8.6	0.242	50 - 75
SW-11	8.11	8.23	10.9	0.246	20 - 30
SW-12	8.00	8.99	7.0	0.239	35 - 40
SEEP-1	7.29	4.20	10.4	0.414	< 1
SEEP-2	8.03	9.72	7.4	0.384	< 0.5

mg/L = milligrams/Liter
C - degrees Celsius
mS/cm - millisiemens per centimeter
NA - Not Available

Table 7
Summary of XRF Metal Concentrations by Area
Yankee Mine Site
Utah County, Utah
August 2002

All Concentrations are mg/kg (ppm)

	Zinc					
Location	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Total Number of Samples
Global	1,284	2,564	200%	ND	13,000	24
L-94	4,328	6,110	141%	280	15,000	5
Scotchman	938	1,000	107%	140	2,400	4
Yankee North	1,984	4,526	228%	ND	28,000	41
Yankee South	1,348	2,029	151%	160	7,200	11

	Arsenic					
Location	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Total Number of Samples
Global	153	204	134%	ND	710	24
L-94	150	126	84%	ND	300	5
Scotchman	ND	NA	NA	ND	ND	4
Yankee North	194	277	143%	ND	1,600	41
Yankee South	102	99	97%	ND	380	11

	Lead					
Location	Mean	Standard Deviation	Standard Error	Minimum	Maximum	Total Number of Samples
Global	3,543	3,545	100%	120	16,000	24
L-94	3,219	5,500	171%	85	13,000	5
Scotchman	2,744	4,054	148%	45	8,700	4
Yankee North	2,891	3,316	115%	93	16,000	41
Yankee South	1,531	1,975	129%	ND	5,800	11

ND = Not Detected at concentrations above the detection limit.
mg/kg = milligrams/kilogram
ppm = parts per million

Figures

TARGET SHEET

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DOCUMENT DESCRIPTION:

FIGURE 1 SITE LOCATION MAP YANKEE MINE SITE, UTAH CO., UTAH

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DOCUMENT DESCRIPTION:

FIGURE 2 WATER SAMPLE LOACTIONS YANKEE MINE SITE UTAH CO., UTAH

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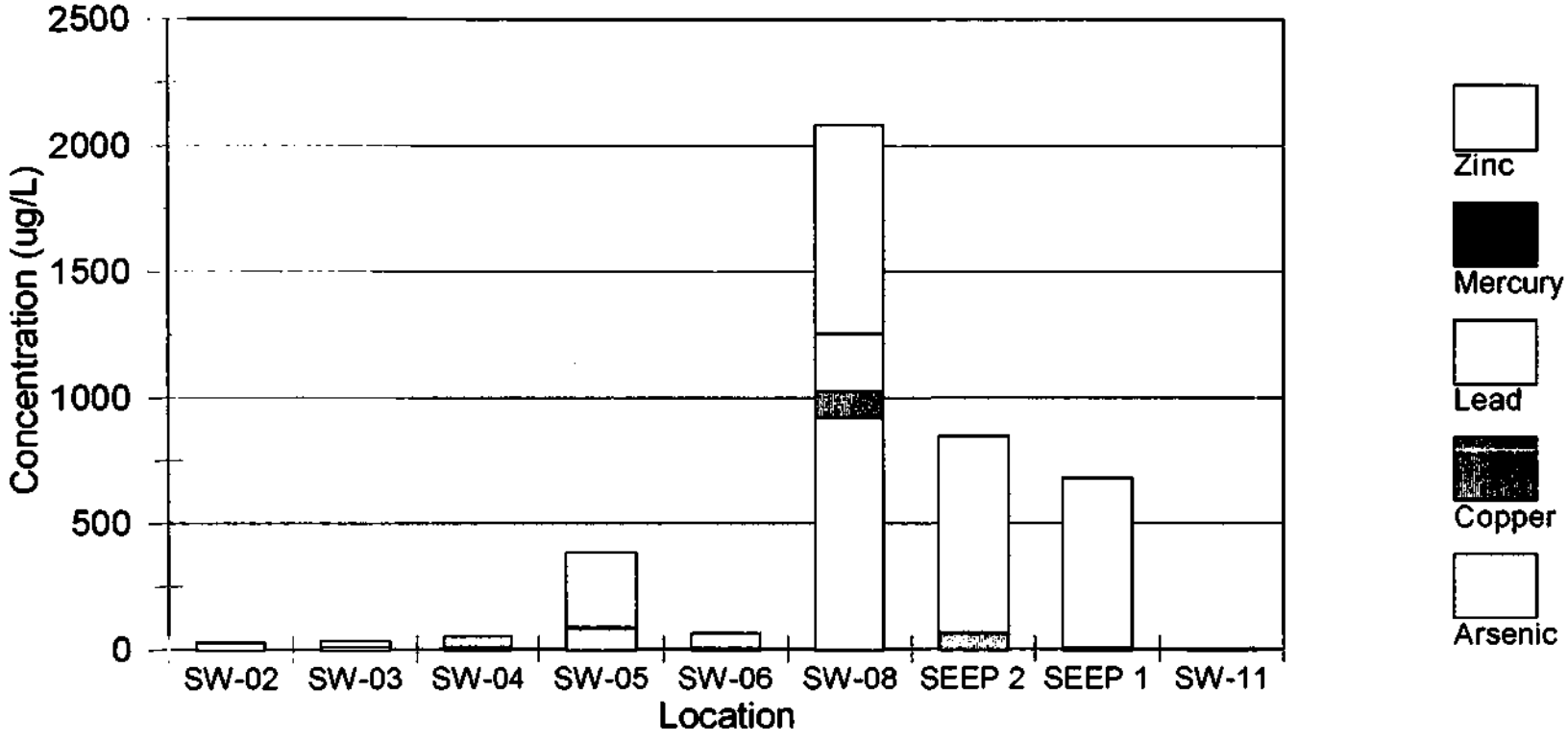
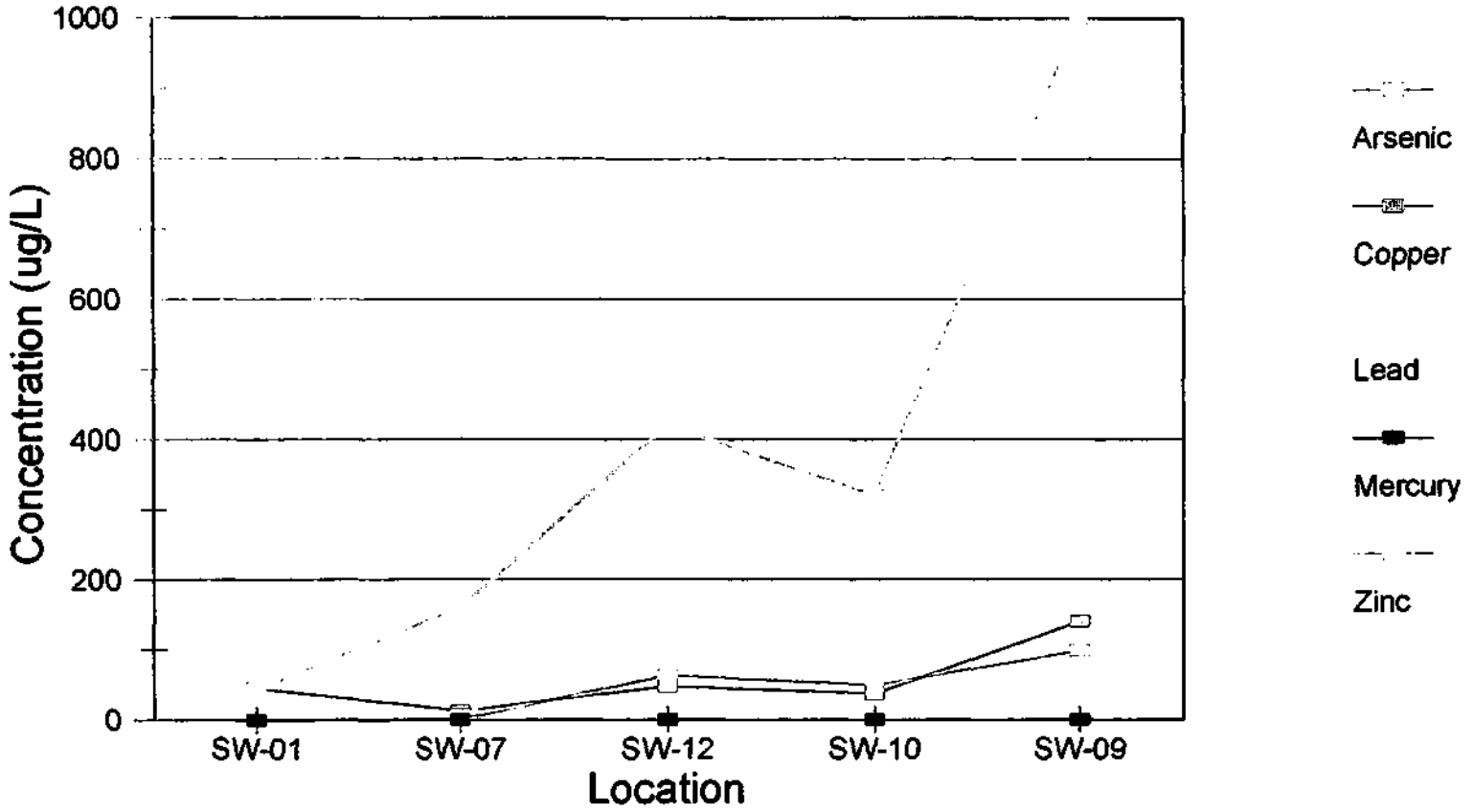
Comparison of Metal Concentrations in Mine Adits and Springs



U.S. EPA Environmetal Response Team Center
Response Engineering and Analytical Contract
68-C99-223
W.A. # R1A00232

Figure 3
Metals in Mine Discharges and Springs
Yankee Mine Site
Utah Co., Utah
July 2002

Surface Water Metal Concentrations in Mary Ellen Gulch



U.S. EPA Environmetal Response Team Center
Response Engineering and Analytical Contract
68-C99-223
W.A. # R1A00232

Figure 4
Comparison of Metal Concentrations in Mine Discharges, Seeps, and Springs
Yankee Mine Site
Utah Co., Utah
August 2002

TARGET SHEET

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DOCUMENT DESCRIPTION:

FIGURE 5 SOIL SAMPLE LOCATION MAP

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DOCUMENT DESCRIPTION:

FIGURE 6 XRF LEAD CONCENTRATION IN SOILS

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DOCUMENT DESCRIPTION:

FIGURE 7 XRF ZINC CONCENTRATION IN SOILS

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DOCUMENT DESCRIPTION:

FIGURE 8 ZRF ARSENIC CONCENTRATIONS IN SOILS

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Appendix A

Appendix A
Field Documentation
Yankee Mine Site
Unita National Forest, Utah
August 2002

RIA00232

10/1/01 Yankee Mine Site
Field Sampling

Scott Grossman REAC
Larry Kaplin REAC
Roxanna Hinzman REAC
Alan Humphries ERT
~~Rick Stephenson - Region 8 OSC~~
Bill Larow START

Surface Sampling - top Inches
4 oz jar - Filled

Loc 1 - GPS - Near Stream
crossing road 5:00 Mix of gravel tailings

Loc 2 5:04 PM MT

Loc 3 5:04

Loc 5 5:08

Loc 4 5:10

Loc 8 5:13
Same as 10

Loc 6 5:15

Loc 9 top of tailings pile edge
10/1/01 YM cont

Loc 7 5:17
Same as 9

Loc 10 5:22
Centre road tailings pile native soil?

Loc 12 5:25 Native soil/Road near large wooden building

Loc 11 5:27
tailings berm of small pond

Loc 14 5:3 Native soil/Roadbed

Loc 13 5:28
tailings berm of small pond

Loc 15 5:34 Roadbed native soil

Loc 16 5:34 Roadbed - native soil

Loc 17 5:38 - Tailings by old wooden frame

Loc 19 5:39 Tailings near Tram Base across from ore shoot

Loc 18 5:38 ~~Ore~~ Ore Shoot Sample

Loc 20 5:40 End of tram Line

10/2/07
Left hotel 7:00AM
Arrive Staging 7:45
Arrive Site 9:20

"Transect #1" W-E

#21 sample 1000 am
fine grain ~~wet~~ light gray
to coarse gravel
North side ~~of~~ site
TP 40-50 Ft W-E
20-30 Ft N-S

Top of Pile
North Edge of Pile

#22 red/gray 1005
fine silt to coarse gravel
>100 Ft down from top of pile

#23 1015 Large rock outcrop
Lt Brown / orange tint
fine grain silt / coarse gravel

#24 Med Gray 1020
Mostly Fine & Soft gravel

#25 10 Ft from Creek 1025
Lt brown fine grain
organic / topsoil

#26 South of 25 1030 west side of creek
30 Ft from Creek
medium gray, fine
near ME-1244RBI orange tape @ creek

#27 Lt Brown Fine grain 1035
White Precip 5' from creek

#28 Coarse grain 1045
brown / tan
scattered red, gray, yellow
20 Ft from creek

#29 Fine gray / Lt brown 1050
Small Gravel

#30 Grass clumps 1100
Damp
Gray @ surface, brown underneath

#31 ≅ 1/2 acre grasses 1105
seeps, moist soil hydric

32 Gray/Tan on top 1115
pea gravel
brown soil below

30 Ft in creek
50 Ft downstream of confluence
steep gulley to creek

ride back up to staging area

~~1206~~ 1207 #33
Fine med brown
red specks
Large gravel area
erosion zone
75' from creek

34 2' deep erosion channel
near toe of large pile
Area B
Hard surface
Fine med brown / gravel

1215 #35 fine med brown
mixed gravel
erosion channel
base of pile

#36 fine well brown
South edge of Pile B
base of pile

#37 1227 Fine grayish brown
Downslope of Pile B

#38 50' down base of Pile B silt
Iron Reddish Iron color / clay
White precip layer on surface

#39 1239 Fine brown silt
Lower Pile C

#40 Gray / beige specks
fine grain silt

#41 fine grain silt 1250

#42 1405 GPS 6' E of actual
Drk gray
medium size
Pile B - Main Pile
on face, 60' from top

#43 Lt gray
compacted, hard surface
fine silt/med gravel
face of Pile B

#44 Reddish/Lt gray
W side of Pile B
50' fm top

#45 ~~Lt~~ Gray
orange specks
W edge of Pile B
100' fm top

1500 #46 Med gray
center of
hard surface

#47 Lt gray chunks
crushed stone
E side of Pile

1512 #48 Gray chunks soft
med gravel

1520 #49 two ft erosion ditch
W side Pile B
orange Brown
gravel, fine silt

1556 #50 Far west log Pile B gray gravel
near the top. Just east of
where the water goes underground
Soil Gray fine, with gravel

1630 #51 Former Mill Site
Below railway
East of Creek
Dry silty topsoil

Time	No.	Description
1645	52	Former mill site Campsite Br. dry silty topsoil
~~1445~~ 1645	53	Former mill site ~~Dg~~ Diversion? Berm, former mill site Brown, dry silty topsoil
1650	54	10 x 10 FT pile near creek coarse soil / gravel white precip tailings?
1715	# 55	Red + gray fine silt to course next to creek
1720	# 56	Reddish, coarse Pile next to creek tailings washed down from mine?
1740	returned to truck	

10/3/01

Arrive @ staging ~ 8AM, to site ~ 9:15 AM

Danny Karalyn remained at staging area to do XRF. Alan, Bill, Pete, Scott, and Ron went to site to collect soil, sediment and water samples

Weather - clear and sunny. 50s in AM, expected 70's in afternoon

Plume L-94

#57 9:58 Plume L-94 - about 2/3 up the pile on eastern side - Gray medium to fine grained

#58 - 9:55 AM - Plume L-94 - towards bottom of pile toward west side. Light gray color - medium to fine grain

10:02 #59 - Small pile on east side of big pile - Light grayish gray medium to fine grained

#60 10:08 - Small light gray pile at back of big pile - Gray soil of hard and chunky

10/3/01

#61 10:15 - Top of big pile at Plume 2 94. Fine grained gray w/ lots of gravel

#62 10:25 Background Soil location - taken from east side of bank. Collocated w/ previous (by whom?) sampling MEG85 (USFS)

~~[illegible]~~ SW-01 10:27 - collected from drainage creek - collocated w/ MEG85 - Forgot the Horiba - so collected an additional bottle to measure at the car.

#63 10:37 Globe mine Wood pile - mid-way + white-gray fine grain - hard w/ crumbable chunks

10:42
#64 Top of big pile - light brownish gray w/ white precipitate on top. Very compact

#65 10:48 NE side of big pile Globe Mine. Dark gray fine grain - very compact

#66 10:54 Globe Mine Top of middle pile - light brown medium grain compact

#67 Light pile left of #66 10:55 Semi fine - [illegible]

#68 10:58 Light gray - silty soil. Fine grained - from east side of lower middle pile

#69 10:08 Fine grain - crushable pea size gravel - light brownish orange

#70 11:15 East of #69
Light gray - very compact

73 ~~#72~~ 11:22 Bottom pile - near top - Light brownish buff color - fine grain - Compact

#71 11:20 Very fine gray - dry. From pile just below waterfall - on ~~[illegible]~~ south slope

11:26 #72 - Same slope - further downstream - brown - fine grain.

#74 11:34 Small pile right next to creek. Medium brownish w/ some gray fine grained

#75 11:44 Dark gray - fine grained, compact, Off east slope near creek - drainage from adit - near culvert

#76 11:46 - gray (light) fine grained sand w/ gravel from pile between creek + drainage

11:51 #77 - greenish ~~[illegible]~~ precipitate only on surface covered from toe of pile near creek fine grain - damp so clumps)

#78 - 11:51 Dark gray from top of pile - fine to coarse grain - taken near end of the

#79 11:53 - taken from top of pile - south end - brown to light gray (mostly) - fine grain

#80 11:59 top of pile @ terminus - above culvert - gray fine grain with some lighter brown - 1/2" deep

#81 Collected @ 12:25
Grey f.g. to c.g. large amount of pyrite

12:30

SS Fine gravel compact beige/grey color

*83 12:33 - Gray w/ whitish surface fine grained Taken from slope below road bed

*84 12:36 From pile adjacent to road. Light brown color fine to medium grained

*85 ~12:40 From gray pile near bushes - just above green precipitate. Dark gray fine grain

SW-01 Hach Readings

pH	8.31
Cond	0.194
Turb	3
DO	8.59
Temp	13.8
SCI	0.00

SW samples collected in HCl poly by hand.

*86 ~1300 Light gray + fine to coarse gravel + medium road

Depth Samples
with noted angles

*9 - 1st depth 14:29
Brownish layer
* Orange layer
* Gray layer
2 ft - Yellow rubber gloves
2 ft - Gray clay w/ some yellow stuff on top
4 ft - dark brown - looks like it has clay - looks wet

#11 Depth sample 14:35

1 ft was dark gray coarser w/ good amount of 1" gravel

2 feet - light gray with white - medium grained

Refusal at 2½ feet

SW - Surface water

Seeps - Adit discharge

3:15 pm

Sensor - 25 sal/min

Cond	0.645/cm
Temp	7.9°C
pH	7.83
DO	11.3

SW-03 @ Cond .509
DO 7.89
Temp 13.7
puddle in the sun pH 8.12

flow 4 1/2 gal/min Adit discharge

1530 Arrived at SW-04, Adit discharge
paddle, sun, flow 4½ gal/min
Cond: .596
DO: 8.5
Temp: 12.8
pH: 8.2
Collected using stainless plastic scoop into 1L poly

Arrived at SW-05 @ 1537
Cond: .228 flow 7.5 gal/min
Temp: 7.2
DO: 7.85
pH: 6.72

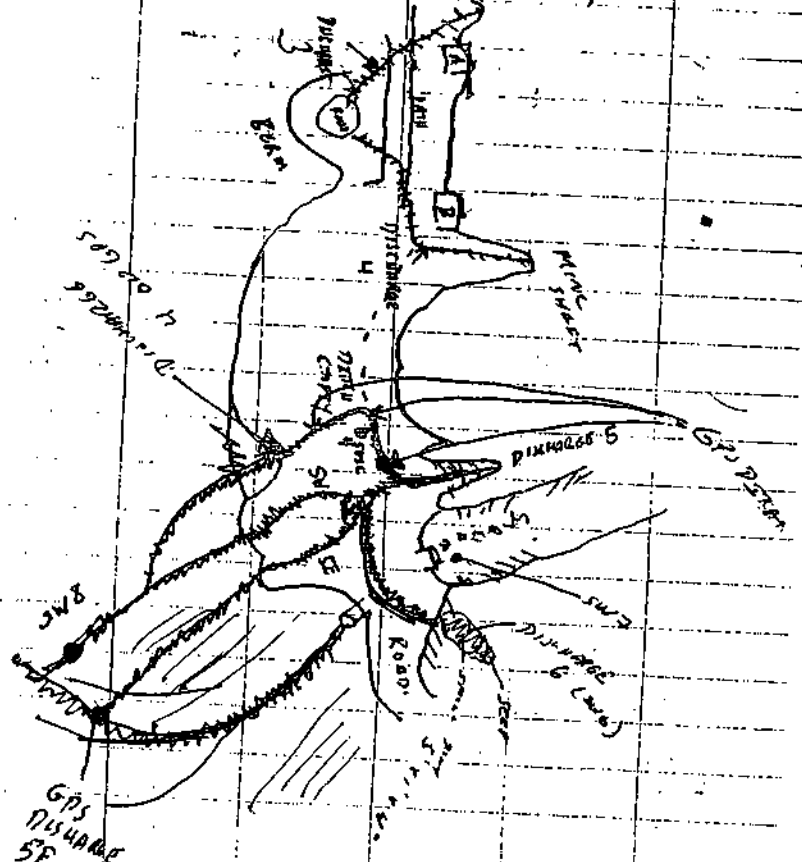
Arrived @ SW-06 @ 1545, flow, 3 gal/paddle
Temp: 13.2
Cond: .324
pH: 7.10
DO: 5.49
collected w/ plastic scoop

1550 Arrived @ SW-07, flow 10-15 gal/min
DO: 9.29 pH: 7.65
Temp: 7.1 Cond: .203 us/cm

1600 SW-08

Temp 7.7
Cond 0.013
DO 9.20
pH 7.49

discharge after flowing over tailings, before main stream from #5 adit discharge



Discharge 2 OUT OF MTN moisture FLOW

Discharge 3 OUT OF GROUND SEEP FLOW

Discharge 4 OUT OF MINE SHAFT SLIGHT FLOW

Discharge 5 BIGGEST FLOW OUT OF GROUND DRIPS BUBBLES

Discharge 6 OUT OF GROUND TRICKLE FLOW RUNS INTO DITCH

SW-09 4:45 Collected with YSI 556 MPS ME-1484
Temp - 10.244
Cond - 8.74
DO - 9.3
pH - 7.97
Flow 125 gal/min. (estimated)

10/3/01 cnl

Seep-01 4:53
Weather has stopped. Seep discharging from the settling pond.
pH 7.29
Cond 0.414
DO 4.20
Temp 10.4

Flow ~1 gal/min
by hand directly into poly

SW-10 17:05
75 ft downstream of confluence of upper streams

Temp 8.6
pH 7.95
Cond 0.242
DO 8.84
Flow ~~5~~ 50-75 gal/min

SW-11 17:10
Sample taken Right facing upstream) stream
pH - 8.11
Cond - 0.246
DO - 8.23
Temp - 10.9
Flow ~20 gal/min to 30 gal/min

SW-12 17:15
USGS ME 1354 - Collected
Flow ~35-40 gal/min
DO - 8.99
Temp - 7.00
pH - 8.00
Cond 0.239
(Sample taken Left bank Right facing upstream)

Seep coming into left tr.b on left bank about 30 ft downstream from SW 12 and about [illegible] upstream from the confluence. Was real flow. Unable to collect a sample

Seep #2 17:26
Coming off P.U. B (Main Pile)
Draining the big grassy area at toe of pile
Flow < 1 L/min

Cond = 0.384
DO = 9.72
Temp = 7.4
pH = 8.03

15 ft downstream from USFS ME-13 12

17:54
#87 - At toe of pile w/ the ore shoot. At toe of pile in light green area. Sample is light green - fine

15:48
#88 At right toe of pile looking up. Brownish coal area. Sample brown - fine with gravel

#89 ~ 1745 Base of South pile (area A) Southedge to brown

#90 ~ 1750 Base of South pile light brown to grey. Just further South than #89

#91 18:00
South Berm to drainage
pond. Light gray - fine
top of Berm

#92 1800
North Berm - top of
drainage pond
Light gray - fine

#93 18:04
North Berm - foot near
pond - White to light
gray with some dark
brown

#94 - 1810
At the very bottom of the
South berm next to
the grass. Sample in
yucky muck with
green moss. Sample
mostly organic

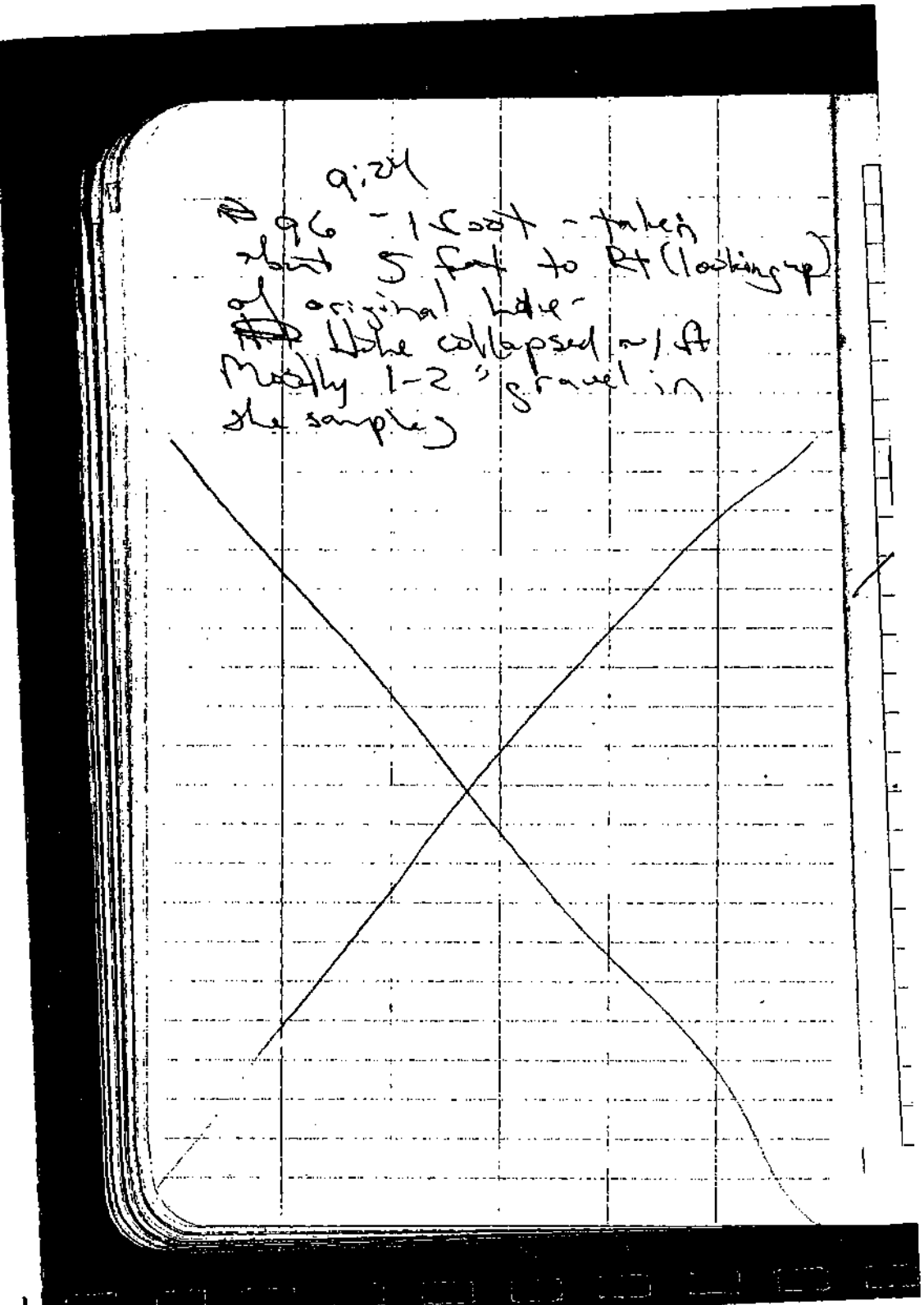
10/4/01
Scutchman
Not Scutchman
Clear and cool (~40°F)
Soil Sampling at Scutchman

#95 9:11 AM - Bottom of
pile. Sample light brown,
mostly gravel. What soil
was there was fine grained

#96 9:17 AM Top of pile center
at Scutchman. Soil
light brown - fine grained
[illegible] depth sample at
this location

#97 9:20 Top of pile
to left of #96 (if facing the top
of the pile) Soil dark brown
fine grain. Small black rocks
covering surface

#98 9:26 Top of pile
Rt of #96 when facing up -
Gravel on top is gray, soil
beneath is light brown fine
grain, compact


9:24
96 - 15.8 ft - taken
about 5 feet to Rt (looking up)
of original hole
Hole collapsed ~1 ft
Mostly 1-2" gravel in
the sample)

Appendix B

Appendix B
XRF Final Trip Report Yankee Mine Site
Unita National Forest, Utah
August 2002

DATE: 16 August, 2002

TO: Scott Grossman, REAC Task Leader

FROM: Lawrence Kaelin, REAC Chemist/Acting Geology Group Leader

SUBJECT: FPXRF ANALYSES, YANKEE MINE SITE, UNITA NATIONAL FOREST, UTAH
WORK ASSIGNMENT 0-232 - FINAL TRIP REPORT

BACKGROUND

A Spectrace 9000 Field-Portable X-ray Fluorescence (FPXRF) analyzer, maintained and operated by Response Engineering and Analytical Contract (REAC) personnel, was used to support United States Environmental Protection Agency/Environmental Response Team Center (U.S. EPA/ERTC) activities at the Yankee Mine site. REAC personnel analyzed site surface and subsurface soil samples for the primary target elements: zinc (Zn), arsenic (As), and lead (Pb).

REAC personnel were at the site from 02 to 04 October 2001, to determine the extent of target element contamination in site soil (mine tailings) samples utilizing a Spectrace 9000 FPXRF analyzer (S/N Q-011). Over 100 soil samples and duplicate samples were analyzed via FPXRF while on site. Twenty eight duplicate samples, including three (3) replicate samples, were sent to REAC, Edison, NJ, for confirmatory laboratory analyses.

OBSERVATIONS AND ACTIVITIES

Spectrace 9000 FPXRF Analyses

The Spectrace 9000 FPXRF measurement times (instrument live-time) were 60 seconds for the cadmium-109 (Cd-109) source, 60 seconds for the iron-55 (Fe-55) source, and 60 seconds for the americium-241 (Am-241) source.

Sample preparation, analysis, and quality assurance/quality control (QA/QC) procedures used in this study conform to those described in the U.S. EPA/ERTC REAC Standard Operating Procedure (SOP) #1713, *Spectrace 9000 Field Portable X-ray Fluorescence Operating Procedure.*

Preliminary results for target elements were reported on a daily basis during the site visit. All preliminary FPXRF on-site field results were QA-1 (screening) level data only. Confirmatory laboratory analyses were later determined on a subset of duplicate samples for the Target Analyte List (TAL) metals to raise the FPXRF results to QA-2 (definitive) level data.

Soil samples were received on site in labeled plastic bags or glass jars. Most samples were dry as received. Each sample was mixed with a spoon. Wet samples were prepared by placing 10-20 grams of the sample in a labeled aluminum weighing dish and oven drying for 1-2 hours as necessary. The dry sample was passed through a 10-mesh stainless steel sieve to remove rocks and large organic matter. The sample was then placed in a labeled 31-millimeter (mm) polyethylene X-ray sample cup and sealed with 0.2-mil (5 micrometer) thick polypropylene X-ray window film. Duplicates were prepared for approximately every 10th sample and the suffix "DUP or DU" was added to the sample ID for the duplicate sample. Prior to XRF analysis, each sample cup was tapped against the tabletop to pack the sample evenly against the film window. The sample cup was placed directly on the probe aperture window of the Spectrace 9000 FPXRF analyzer, the safety shield was closed, and analysis was initiated with the measurement times previously noted.

XRF analysis results for each sample were saved in the Spectrace 9000 internal data logger memory. The data were

downloaded and archived on computer disks on a daily basis. Target element results for each analyzed sample and standard were logged into the Spectrace 9000 field logbook. Target element results were qualified using the method detection and quantitation limits discussed below in this report. Table 1 summarizes the qualified FPXRF results.

QA/QC Procedures

The reliability of the Spectrace 9000 FPXRF unit and application model was evaluated daily during the site visit. The energy calibration check and detector resolution check were performed at the beginning of each day to ensure that proper instrument calibration was maintained and that the detector resolution was adequate for producing reliable X-ray intensity measurements. The Spectrace 9000 soil application model was verified at the beginning of each day for the target elements. This was accomplished by analyzing a blank sand sample (Mallinkrodt, Lot # 7062KJHP) and National Institute of Standards and Technology (NIST) Standard Reference Materials (SRMs) #2709, #2710, and #2711. Energy calibration checks, detector resolution checks, and application verification results were recorded in the Spectrace 9000 field logbook.

Method Detection and Quantitation Limits

A certified standard, NIST SRM #2709, was analyzed at the beginning of each day and periodically during sample analysis to establish statistically derived method detection and quantitation limits for the target elements. The standard deviation [STD (n-1)] for these analyses was used to calculate the Spectrace 9000 method detection limit (MDL) and method quantitation limit (MQL) for each target element. The MDL was calculated for each element as three times the standard deviation (MDL = 3 x STD) and the MQL was defined as ten times the standard deviation (MQL = 10 x STD) for repeat measurements of SRM #2709. The reported MDL was based on this calculation for both Pb and Zn. Lead interferes with the As analysis at Pb:As ratios of 5:1 or greater. Therefore, the reported As MDL was the statistical value or 1/10 the Pb concentration, whichever was greater. The MDLs and MQLs were calculated daily for the reporting of field data. An average MDL and MQL for the entire period from 02-04 October, 2001, was used to qualify the compiled field results in Table 1 and appears at the end of the table. Appendix A has the raw data used to calculate the daily and average MDLs and MQLs.

Spectrace 9000 results were qualified by a "U" for analyses with results less than the MDL (not detected). All preliminary FPXRF results determined in the field were QA-1 (screening) level data only. FPXRF results above the MDL but below the MQL were qualified by a "J" and represents results in a region of some statistical uncertainty. The daily field screening FPXRF results are in Appendix B.

FPXRF Confirmation Samples

In order to obtain a "definitive"QA-2 level for the FPXRF data set, a minimum of 10 percent of the field samples must be confirmed by a laboratory method such as Inductively-Coupled Plasma (ICP) emission spectroscopy or Atomic Absorption (AA) analysis. A regression analysis between the Spectrace 9000 data (independent) and the confirmatory data (dependent) must yield a coefficient of determination (r^2) greater than 0.7 (U.S. EPA/ERT 1991). The model obtained by the regression may be used to validate or adjust the Spectrace 9000 data.

Twenty-eight (28) of the soil/sediment samples, including three (3) replicates, analyzed by FPXRF methods were selected by the Task Leader and submitted for confirmatory (TAL metals) laboratory analysis. To minimize potential sample homogeneity problems, the same XRF sample cups were submitted for confirmatory analysis. Confirmatory laboratory results for TAL metals are presented in Table 2.

Results

Table 1 contains qualified FPXRF results for target elements. Appendix A contains the MDL, MQL, linear regression data, and QA/QC data. Preliminary FPXRF field results for all samples are in Appendix B. Copies of field logbook entry pages are in Appendix C. Table 2 has the TAL metal confirmatory laboratory results. Table 3 compares the FPXRF and TAL confirmatory results for samples above the detection limits, along with a determination of their relative percent differences (RPD).

Lockheed Martin Technology Services
Environmental Services REAC
2890 Woodbridge Avenue Building 209 Annex
Edison, NJ 08837-3679
Telephone 732-321-4200 Facsimile 732-494-4021

LOCKHEED MARTIN

DATE: August 30, 2002

TO: Alan Humphrey, U.S. EPA/ERTC Work Assignment Manager

THROUGH: Gary Newhart, REAC Operations Section Leader

FROM: Scott Grossman, REAC Task Leader

SUBJECT: DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT 0-232

Attached please find the following document prepared under this work assignment:

FINAL REPORT
YANKEE MINE SITE
UTAH COUNTY, UTAH

cc: Central Files WA #0-232 (w/attachment)
Dennis Miller, REAC Program Manager (w/o attachment)

0232\DFR\083002

FPXRF Results

The highest Zn result via FPXRF was determined on sample 29 at 28,000 milligrams per kilogram (mg/kg), the highest As result via FPXRF was determined on sample 44 at 1,600 mg/kg, and the highest Pb result via FPXRF was determined on sample 9-2 at 18,000mg/kg. Duplicate sample XRF cups were prepared whenever possible. FPXRF analyses of duplicate cups were determined and both results are presented in Table 1. In most cases the RPD of the duplicates were less than 50 percent (%). In the cases where the RPD was above 50% the XRF sample was reanalyzed (sample suffix "RR"), the outlier results was omitted, and a new RPD determined. In all cases this resulted in a RPD for duplicate FPXRF analyses below 50%.

Reference samples NIST SRM #2720, 2711, and R33, with known values of Zn, As, and Pb, were analyzed via FPXRF. The RPD was determined comparing only data sets above the FPXRF MQLs. In all cases the RPDs for NIST SRM samples were below 50%.

All Spectrace 9000 FPXRF daily instrument checkout criteria were met during the sampling period, as per SOP #1713. The comparison of FPXRF analysis of duplicate XRF cups and NIST SRM reference samples were acceptable during the sampling period (RPD< 50%).

TAL Metals Results

The highest Zn TAL metals result was determined on sample 29 at 59,000 mg/kg, the highest As TAL metals result was determined on sample 44 at 1,500 mg/kg, and the highest Pb TAL metals result was determined on sample 61 at 95,000 mg/kg. Three replicate samples were submitted for TAL metals analysis and the RPDs determined. In all case the RPDs were below 50 %. Table 2 summarizes the TAL metals confirmatory laboratory results.

FPXRF vs. TAL Metals Results

Table 3 summarizes the comparison of FPXRF field results and the corresponding TAL metals confirmatory laboratory results. The overall RPD for the target metal was less 50% with Zn at 24.8%, As at 49.8%, and Pb at 51%. Linear regression analysis of the FPXRF field analysis vs. TAL metals confirmatory laboratory analysis yielded the following R^2 values: Zn = 0.96, As = 0.71, Pb (all values above MDL) = 0.45, and Pb (all values above MDL, below 10,000 mg/kg) = 0.71. The regression analysis shows that the FPXRF field results were sufficiently validated ($R^2 > 0.7$) against the confirmatory laboratory analysis for Zn and As at all the ranges tested, and for Pb only at concentrations below 10,000 mg/kg. As such, all Zn and As FPXRF data can be considered QA-2 level data and only Pb FPXRF data below 10,000 mg/kg can be considered QA-2 level data. FPXRF results above 10,000 mg/kg Pb are therefore suspect and remain QA-1 level data. Appendix A has the complied QA/QC data and linear regression results.

Table 1
Qualified FPXRF Screening Results
Yankee Mine Site
Unita National Forest, Utah
August 2002

Sample	Date	Zinc (Zn)	Arsenic (As)	Lead (Pb)
SAMP1	2 October 2001	630	150 J	800
SAMP1DUP	2 October 2001	780	150 J	610
SAMP2	2 October 2001	5400	240 J	4300
SAMP2RR	2 October 2001	1900	U	4500
SAMP2DUP	2 October 2001	1900	U (500)	5000
SAMP3	2 October 2001	530	U (72)	2100
SAM3DUP1	2 October 2001	830	U (72)	2200
SAM3DUP2	2 October 2001	520	U (72)	2000
SAMP4	2 October 2001	4700	U (72)	8800
SAMP4DUP	2 October 2001	5400	U (72)	8300
SAMP5	2 October 2001	1800	U (72)	4200
SAMP5DUP	2 October 2001	1400	U (72)	3600
SAMP6	2 October 2001	890	U (72)	1700
SAMP6DUP	2 October 2001	1000	U (72)	1800
SAMP7	2 October 2001	2600	U (72)	7200
SAMP7DUP	2 October 2001	3000	U (72)	7200
SAMP8	2 October 2001	200 J	U (72)	88 J
SAMP8DUP	2 October 2001	200 J	U (72)	98 J
SAMP9	2 October 2001	420	150 J	480
SAMP9DUP	2 October 2001	240 J	140 J	470
SAMP10	2 October 2001	2800	U (160)	1600
SAM10DUP	2 October 2001	2600	180 J	1400
SAMP11	2 October 2001	U	U (72)	1600
SAM11DUP	2 October 2001	110 J	U (72)	1900
SAMP12	2 October 2001	1800	540	520
SAMP13	2 October 2001	290 J	U (72)	1100
SAMP14	2 October 2001	990	220 J	870
SAMP15	2 October 2001	600	100 J	180
SAMP16	2 October 2001	680	150 J	320
SAMP17	2 October 2001	560	U (200)	2000
SAMP18	2 October 2001	7500	U (72)	6100
SAM18DUP	2 October 2001	6800	U (72)	5400
SAMP19	2 October 2001	160 J	U (110)	1100
SAMP20	2 October 2001	2100	U (72)	4600
SAMP21	3 October 2001	U	U (72)	260
SAMP22	3 October 2001	330 J	130 J	1200
SBMP23	3 October 2001	1000	350	1700
SAM23DUP	3 October 2001	620	190 J	1700
SAMP24	3 October 2001	510	U (72)	2100
SAMP25	3 October 2001	1100	U (450)	4500
SAMP26	3 October 2001	730	U (72)	2600
SAMP51	3 October 2001	1100	U (72)	1100

Table 1 - Continued
Qualified FPXRF Screening Results
Yankee Mine Site
Unita National Forest, Utah
August 2002

Sample	Date	Zinc (Zn)	Arsenic (As)	Lead (Pb)
SAM51DUP	3 October 2001	1100	U (72)	1100
SAMP52	3 October 2001	2100	U (72)	2600
SAM52DUP	3 October 2001	2300	U (72)	2400
SAMP53	3 October 2001	420	U (72)	230
SAM53DUP	3 October 2001	420	U (72)	280
SAMP27	3 October 2001	1200	U (72)	920
SAMP28	3 October 2001	8800	U (72)	13000
SAM28DUP	3 October 2001	11000	U (72)	15000
SAMP29	3 October 2001	28000	U (72)	16000
SAMP30	3 October 2001	1300	370	1600
SAMP32	3 October 2001	11000	U (72)	14000
SAMP33	3 October 2001	200 J	650	1200
SAMP34	3 October 2001	680	410	2200
SAMP35	3 October 2001	2800	600	4000
SAMP36	3 October 2001	3600	U (72)	3700
SAMP38	3 October 2001	250 J	U (140)	1400
SAM39DUP	3 October 2001	650	U (380)	3800
SAMP40	3 October 2001	2200	U (72)	2600
SAM41DUP	3 October 2001	160 J	130 J	670
SAMP31	3 October 2001	790	340	2700
SAMP37	3 October 2001	1700	350	2200
SAMP42	3 October 2001	120 J	U (72)	2400
SAMP43	3 October 2001	130 J	170 J	690
SAM43DUP	3 October 2001	310 J	130 J	870
SAMP44	3 October 2001	310 J	1600	410
SAMP45	3 October 2001	760	240 J	920
SAMP46	3 October 2001	170 J	U (72)	2400
SAMP47	3 October 2001	130 J	U (72)	2000
SAMM48	3 October 2001	600	U (480)	4800
SAMP49	3 October 2001	1600	U (290)	2900
SAMP50	3 October 2001	340	87 J	80 J
SAMP54	3 October 2001	1500	950	6800
SAM54DUP	3 October 2001	2700	810	5500
SAMP55	3 October 2001	3200	500	2200
SAMP56	3 October 2001	1700	U (910)	9100
SAM56DUP	3 October 2001	1200	U (72)	7800
SAM56DRR	3 October 2001	1400	U (72)	7900
SAMP57	3 October 2001	1600	270	830
SAMP58	3 October 2001	960	100 J	480
SAMP59	3 October 2001	280 J	300	85 J
SAMP60	3 October 2001	3800	U (72)	1700
SAMP61	3 October 2001	14000	U (72)	12000

Table 1 - Continued
Qualified FPXRF Screening Results
Yankee Mine Site
Unita National Forest, Utah
August 2002

Sample	Date	Zinc (Zn)	Arsenic (As)	Lead (Pb)
SAM61DUP	3 October 2001	15000	U (72)	13000
SAMP62	3 October 2001	820	320	120 J
SAMP63	3 October 2001	610	U (72)	4700
SAMP64	3 October 2001	13000	U (72)	16000
SAMP65	3 October 2001	300 J	U (72)	830
SAMP66	3 October 2001	320 J	710	530
SAMP67	3 October 2001	300 J	650	290
SAMP68	3 October 2001	1200	U (72)	4400
SAMP69	3 October 2001	870	470	160
SAMP70	3 October 2001	150 J	150 J	660
SAMP71	3 October 2001	820	U (72)	2200
SAMP72	3 October 2001	660	420	1200
SAMP73	3 October 2001	1500	U (72)	630
SAMP74	3 October 2001	1200	U (330)	3300
SAMP75	3 October 2001	2300	U (72)	9800
SAM75DUP	3 October 2001	3000	U (72)	11000
SAMP76	3 October 2001	1700	U (72)	4800
SAMP77	3 October 2001	450	U (72)	4900
SAMP78	3 October 2001	870	U (72)	4600
SAMP79	3 October 2001	1100	U (72)	4900
SAMP80	3 October 2001	630	U (72)	5600
SAMP81	3 October 2001	360	U (72)	3900
SAMP82	3 October 2001	670	U (72)	4000
SAMP83	3 October 2001	350	U (72)	1600
SAMP84	3 October 2001	190 J	U (270)	2700
SAMP85	3 October 2001	U	U (72)	3000
SAMP86	3 October 2001	140 J	120 J	900
SAM86DUP	3 October 2001	U	U (72)	900
SAMP87	4 October 2001	1100	U (72)	2100
SAMP88	4 October 2001	1500	380	430
SAMP89	4 October 2001	220 J	U (72)	U
SAMP90	4 October 2001	370	87 J	210
SAMP91	4 October 2001	1900	U (72)	4500
SAM91DUP	4 October 2001	2200	U (72)	4700
SAMP92	4 October 2001	1900	U (360)	3600
SAMP93	4 October 2001	3400	U (420)	4200
SAM93DUP	4 October 2001	2600	U (400)	4000
SAMP9 - 1	4 October 2001	470	810	3000
SAMP9 - 2	4 October 2001	6100	U (72)	18000
SAMP9 - 3	4 October 2001	5900	U (72)	14000
SAMP9 - 4	4 October 2001	430	740	360
SAMP11 - 1	4 October 2001	U	110 J	800

Table 1 - Continued
Qualified FPXRF Screening Results
Yankee Mine Site
Unita National Forest, Utah
August 2002

Sample	Date	Zinc (Zn)	Arsenic (As)	Lead (Pb)
SAMP11 - 2	4 October 2001	U	U (72)	1000
S94 - SURFACE	4 October 2001	21000	U (72)	4800
SAMP95	4 October 2001	140 J	U (72)	45 J
SAMP96	4 October 2001	650	U (72)	1900
SAMP96 - 1	4 October 2001	210 J	89 J	110 J
SAMP97	4 October 2001	2400	U (72)	8700
SAMP98	4 October 2001	560	U (72)	330

All results in parts per million by weight (mg/kg)
U = Results below method detection limit (MDL), As MDL value in parenthesis
J = Results above MDL but below quantitation limit (MQL)

Detection Limit	Zinc	Arsenic [1]	Lead
MDL	102	72	41
MQL	339	240	135

All detection limits are in parts per million by weight (mg/kg)
Arsenic [1] = Arsenic MDL is 72 mg/kg, or 1/10th of corresponding Lead sample result, whichever is higher, when the Pb:As ratio is 5:1 or greater, Arsenic MDL value in parenthesis.

Table 2
Target Analyte List (TAL) Metal Confirmatory Laboratory Results
Yankee Mine Site
Unita National Forest, Utah
August 2002

Location	ARSENIC	LEAD	ZINC
	TAL	TAL	TAL
2*	650	11,000	3,400
4	430	16,000	14,000
7	490	20,000	5,600
10	120	2,600	4,700
10 (DUP)	170	2,300	4,700
12	360	560	1,500
14	290	880	1,600
18	680	20,000	11,000
20	140	4,800	1,500
23	300	1,700	1,300
23 (DUP)	300	1,800	920
25	400	3,800	1,100
28	370	32,000	23,000
29	280	21,000	59,000
32	270	17,000	21,000
35	1,200	5,200	4,400
44	1,500	340	160
50	43	86	240
54	820	21,000	6,700
54 (DUP)	820	25,000	5,100
59	230	95	190
61	560	95,000	29,000
64	520	23,000	20,000
75	160	30,000	5,700
86	81	930	46
97	300	11,000	2,600
9-2'	660	41,000	13,000
9-4'	560	310	360

All concentrations in parts per million, milligram per kilogram (mg/kg)
ND = Not Detected at concentrations above the detection limit.
J = Estimated Value

Table 3
Comparison of XRF and TAL Metal Concentrations
Yankee Mine Site
Unita National Forest, Utah
August 2002

Location	ARSENIC		LEAD		ZINC	
	TAL	XRF	TAL	XRF	TAL	XRF
2*	650	160 J	11,000	4,400	3,400	3,700
4	430	ND	16,000	8,800	14,000	4,700
7	490	ND	20,000	7,200	5,600	2,600
10	120	ND (160)	2,600	1,600	4,700	2,800
10 (DUP)	170	180 J	2,300	1,400	4,700	2,600
12	360	540	560	520	1,500	1,800
14	290	220 J	880	870	1,600	990
18	680	ND	20,000	6,100	11,000	7,500
20	140	ND	4,800	4,600	1,500	2,100
23	300	350	1,700	1,700	1,300	1,000
23 (DUP)	300	190 J	1,800	1,700	920	620
25	400	ND (450)	3,800	4,500	1,100	1,100
28	370	ND	32,000	13,000	23,000	8,800
29	280	ND	21,000	16,000	59,000	28,000
32	270	ND	17,000	14,000	21,000	11,000
35	1,200	600	5,200	4,000	4,400	2,800
44	1,500	1,600	340	410	160	310 J
50	43	87 J	86	80 J	240	340
54	820	950	21,000	6,800	6,700	1,500
54 (DUP)	820	810	25,000	5,500	5,100	2,700
59	230	300	95	85 J	190	280 J
61	560	ND	95,000	12,000	29,000	14,000
64	520	ND	23,000	16,000	20,000	13,000
75	160	ND	30,000	9,800	5,700	2,300
86	81	120 J	930	900	46	140 J
97	300	ND	11,000	8,700	2,600	2,400
9-2'	660	ND	41,000	18,000	13,000	6,100
9-4'	560	740	310	360	360	430

All concentrations in parts per million, milligram per kilogram (mg/kg)
ND = Not Detected at concentrations above the detection limit.
J = Estimated Value

Appendix A
FPXRF MDL, MQL, and QA/QC Data
FPXRF Final Trip Report
Yankee Mine Site
Unita National Forest, Utah
August 2002

Appendix A
FPXRF MDL and MQL Raw Data

oct 2001	Spectrace Unit Q-011						
FPXRF method detection limit (MDL), method quantitation limit (MQL) raw data							
yankee mine wa# 0-232							
60 sec each source, NIST SRM #2709							
	milligrams/kilogram (mg/kg)						
date	Zinc (Zn)	Arsenic (As)	Lead (Pb)			Rounded (mg/kg)	
oct 2	160	91	-19			MDL	MQL
oct 2	145	14	8.4		Zn	102	339
oct 2	181	37	-22		As	72	240
oct 2	170	33	4		Pb	41	135
oct 2	151	34	5				
oct 2	85	63	-22				
oct 2	183	81	4.8				
oct 2	162	43	3.7				
oct 3	119	38	-16				
oct 3	191	7.6	6.7				
oct 3	92	60	-15				
oct 3	181	24	-25				
oct 3	142	70	4.1				
oct 3	118	46	10				
oct 3	137	78	-9.6				
oct 3	188	55	-19				
oct 4	121	45	-25				
oct 4	127	77	1.9				
oct 4	145	14	0.02				
oct 4	198	62	5.3				
oct 4	97	72	17				
n=21							
std dev	33.886786	23.968074	13.512079				
MDL	101.66036	71.904222	40.536237				
MQL	338.86786	239.68074	135.12079				

Appendix A - Continued

QA/QC and Linear Regression Data Data

Yankee Mine Site

Unita National Forest Utah

July 2002

ARSENIC (As)																
TAL	XRF	RPD	CALC-As		Regression Output: As > MDL											
43	87	67.69	85.78	Constant			0									
81	120	38.81	118.32	Std Err of Y Est			235.1327									
650	160	120.99	157.75	R Squared			0.703408									
170	180	5.71	177.47	No. of Observations			14									
300	190	44.90	187.33	Degrees of Freedom			13									
290	220	27.45	216.91													
230	300	26.42	295.79	X Coefficient(s)	0.985968											
300	350	15.38	345.09	Std Err of Coef.	0.098531											
360	540	40.00	532.42													
1,200	600	66.67	591.58													
560	740	27.69	729.62		x = XRF											
820	810	1.23	798.63		y = TAL											
820	950	14.69	936.67													
1,500	1,600	6.45	1577.55		Mean RPD =	24.82	(>MQL)									
LEAD (Pb)																
TAL	XRF	RPD	CALC-Pb		Regression Output: all Pb > MDL						Regression Output: Pb > MDL <10,000					
86	80	7.23	191.97	Constant			0				Constant		0			
95	85	11.11	203.97	Std Err of Y Est			14519.07				Std Err of Y Est		4821.296			
310	360	14.93	863.85	R Squared			0.451722				R Squared		0.741167			
340	410	18.67	983.83	No. of Observations			28				No. of Observations		22			
560	520	7.41	1247.79	Degrees of Freedom			27				Degrees of Freedom		21			
880	870	1.14	2087.64													
930	900	3.28	2159.63	X Coefficient(s)	2.39959		1				X Coefficient(s)	2.382619				
2,300	1,400	48.65	3359.43	Std Err of Coef.	0.337659		4.12E-17				Std Err of Coef.	0.214773				
2,600	1,600	47.62	3839.34													
1,800	1,700	5.71	4079.30													
1,700	1,700	0.00	4079.30		x = XRF											
5,200	4,000	26.09	9598.36		y = TAL											
11,000	4,400	85.71	10558.20													
3,800	4,500	16.87	10798.16		Mean RPD =	49.76	(>MQL)									
4,800	4,600	4.26	11038.11													
25,000	5,500	127.87	13197.75													
20,000	6,100	106.51	14637.50													
21,000	6,800	102.16	16317.21													
20,000	7,200	94.12	17277.05													
11,000	8,700	23.35	20876.43													
16,000	8,800	58.06	21116.39													
30,000	9,800	101.51	23515.98													
95,000	12,000	155.14	28795.06													
32,000	13,000	84.44	31194.67													
17,000	14,000	19.35	33594.26													
21,000	16,000	27.03	38393.44													
23,000	16,000	35.90	38393.44													
41,000	18,000	77.97	43192.62													
ZINC (Zn)																
TAL	XRF	RPD	CALC-Zn		Regression Output: all Zn > MDL											
46	140	101.08	281.96	Constant			0									
190	280	38.30	563.91	Std Err of Y Est			2484.346									
160	310	63.83	624.33	R Squared			0.961401									
240	340	34.48	684.75	No. of Observations			28									
360	430	17.72	866.01	Degrees of Freedom			27									
920	620	38.96	1248.66													
1,600	990	47.10	1993.83	X Coefficient(s)	2.013972											
1,300	1,000	26.09	2013.97	Std Err of Coef.	0.063344											
1,100	1,100	0.00	2215.37													
6,700	1,500	126.83	3020.96													
1,500	1,800	18.18	3625.15		x = XRF											
1,500	2,100	33.33	4229.34		y = TAL											
5,700	2,300	85.00	4632.14													
2,600	2,400	8.00	4833.53		Mean RPD =	51.05	(>MQL)									
4,700	2,600	57.53	5236.33													
5,600	2,600	73.17	5236.33													
5,100	2,700	61.54	5437.72													
4,700	2,800	50.67	5639.12													
4,400	2,800	44.44	5639.12													
3,400	3,700	8.45	7451.70													
14,000	4,700	99.47	9465.67													
13,000	6,100	72.25	12285.23													
11,000	7,500	37.84	15104.79													
23,000	8,800	89.31	17722.95													
21,000	11,000	62.50	22153.69													
20,000	13,000	42.42	26181.64													
29,000	14,000	69.77	28195.61													
59,000	28,000	71.26	56391.22													
All Results are in milligrams per kilogram																

Appendix B
Daily FPXRF Field Screening Results
FPXRF Final Trip Report
Yankee Mine Site
Unita National Forest, Utah
August 2002

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: Orem, Utah
Units: ppm

Sample Code	Date Run	Zn Raw	Zn Qual		As Raw	As Qual	
	Time: 2-O	290.00	290	J	59.00	ND	-
SAMP1	2-OCT-2001	626.06	630	-	152.40	150	J
SAMP1DUP	2-OCT-2001	783.95	780	-	153.05	150	J
SAMP2	2-OCT-2001	5386.45	5400	-	243.29	240	J
SAMP2RR	2-OCT-2001	1880.66	1900	-	43.41	ND	-
SAMP2DUP	2-OCT-2001	1946.48	1900	-	142.44	140	J
SAMP3	2-OCT-2001	532.26	530	-	-12.32	ND	-
SAM3DUP1	2-OCT-2001	830.23	830	-	-44.75	ND	-
SAM3DUP2	2-OCT-2001	515.99	520	-	58.14	ND	-
SAMP4	2-OCT-2001	4674.58	4700	-	-554.56	ND	-
SAMP4DUP	2-OCT-2001	5388.93	5400	-	-218.76	ND	-
SAMP5	2-OCT-2001	1794.15	1800	-	-438.54	ND	-
SAMP5DUP	2-OCT-2001	1431.51	1400	-	-277.28	ND	-
SAMP6	2-OCT-2001	885.43	890	-	-10.72	ND	-
SAMP6DUP	2-OCT-2001	995.38	1000	-	-76.57	ND	-
SAMP7	2-OCT-2001	2557.64	2600	-	-431.65	ND	-
SAMP7DUP	2-OCT-2001	2990.95	3000	-	-364.65	ND	-
SAMP8	2-OCT-2001	202.45	200	J	6.00	ND	-
SAMP8DUP	2-OCT-2001	198.02	200	J	-15.40	ND	-
SAMP9	2-OCT-2001	415.98	420	-	153.46	150	J
SAMP9DUP	2-OCT-2001	241.71	240	J	142.54	140	J
SAMP10	2-OCT-2001	2759.85	2800	-	90.50	91	J
SAM10DUP	2-OCT-2001	2558.87	2600	-	177.76	180	J
SAMP11	2-OCT-2001	91.75	ND	-	0.00	ND	-
SAM11DUP	2-OCT-2001	105.14	110	J	-71.84	ND	-
SAMP12	2-OCT-2001	1830.37	1800	-	543.04	540	-
SAMP13	2-OCT-2001	289.55	290	J	58.71	ND	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

		Zn	As
Minimum Detection Limit (MDL)	=	93	79
Minimum Quantitation Limit (MQL)	=	311	264

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: Orem, Utah
Units: ppm

Sample Code	Date Run	Zn Raw	Zn Qual		As Raw	As Qual	
SAMP14	2-OCT-2001	991.44	990	-	215.18	220	J
SAMP15	2-OCT-2001	603.18	600	-	103.92	100	J
SAMP16	2-OCT-2001	679.13	680	-	146.72	150	J
SAMP17	2-OCT-2001	559.98	560	-	88.21	88	J
SAMP18	2-OCT-2001	7479.15	7500	-	-14.03	ND	-
SAM18DUP	2-OCT-2001	6776.94	6800	-	-218.82	ND	-
SAMP19	2-OCT-2001	164.29	160	J	100.58	100	J
SAMP20	2-OCT-2001	2063.95	2100	-	-98.78	ND	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

		Zn	As
Minimum Detection Limit (MDL)	=	93	79
Minimum Quantitation Limit (MQL)	=	311	264

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: Orem, Utah
Units: ppm

Sample Code	Date Run	Pb Raw	Pb Qual	
SAMP14	2-OCT-2001	869.53	870	-
SAMP15	2-OCT-2001	178.21	180	-
SAMP16	2-OCT-2001	316.90	320	-
SAMP17	2-OCT-2001	1984.16	2000	-
SAMP18	2-OCT-2001	6141.07	6100	-
SAM18DUP	2-OCT-2001	5441.38	5400	-
SAMP19	2-OCT-2001	1143.28	1100	-
SAMP20	2-OCT-2001	4632.24	4600	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

		Pb
Minimum Detection Limit (MDL)	=	41
Minimum Quantitation Limit (MQL)	=	137

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: American Fork Canyon, Orem, Utah
Units: ppm

Sample Code	Date Run	Zn	Qual	As	Qual	Pb	Qual
SAMP21	3-OCT-2001	ND	-	ND	-	260	-
SAMP22	3-OCT-2001	330	J	130	J	1200	-
SBMP23	3-OCT-2001	1000	-	350	-	1700	-
SAM23DUP	3-OCT-2001	620	-	190	J	1700	-
SAMP24	3-OCT-2001	510	-	ND	-	2100	-
SAMP25	3-OCT-2001	1100	-	390	-	4500	-
SAMP26	3-OCT-2001	730	-	ND	-	2600	-
SAMP51	3-OCT-2001	1100	-	ND	-	1100	-
SAM51DUP	3-OCT-2001	1100	-	ND	-	1100	-
SAMP52	3-OCT-2001	2100	-	ND	-	2600	-
SAM52DUP	3-OCT-2001	2300	-	ND	-	2400	-
SAMP53	3-OCT-2001	420	-	ND	-	230	-
SAM53DUP	3-OCT-2001	420	-	ND	-	280	-
SAMP27	3-OCT-2001	1200	-	ND	-	920	-
SAMP28	3-OCT-2001	8800	-	ND	-	13000	-
SAM28DUP	3-OCT-2001	11000	-	ND	-	15000	-
SAMP29	3-OCT-2001	28000	-	ND	-	16000	-
SAMP30	3-OCT-2001	1300	-	370	-	1600	-
SAMP32	3-OCT-2001	11000	-	ND	-	14000	-
SAMP33	3-OCT-2001	200	J	650	-	1200	-
SAMP34	3-OCT-2001	680	-	410	-	2200	-
SAMP35	3-OCT-2001	2800	-	600	-	4000	-
SAMP36	3-OCT-2001	3600	-	ND	-	3700	-
SAMP38	3-OCT-2001	250	J	100	J	1400	-
SAM39DUP	3-OCT-2001	650	-	160	J	3800	-
SAMP40	3-OCT-2001	2200	-	ND	-	2600	-
SAM41DUP	3-OCT-2001	160	J	130	J	670	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

	Zn	As	Pb
Minimum Detection Limit (MDL) =	102	72	41
Minimum Quantitation Limit (MQL)=	339	240	135

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: American Fork Canyon, Orem, Utah
Units: ppm

Sample Code	Date Run	Zn	Qual	As	Qual	Pb	Qual
SAMP31	3-OCT-2001	790	-	340	-	2700	-
SAMP37	3-OCT-2001	1700	-	350	-	2200	-
SAMP42	3-OCT-2001	120	J	ND	-	2400	-
SAMP43	3-OCT-2001	130	J	170	J	690	-
SAM43DUP	3-OCT-2001	310	J	130	J	870	-
SAMP44	3-OCT-2001	310	J	1600	-	410	-
SAMP45	3-OCT-2001	760	-	240	J	920	-
SAMP46	3-OCT-2001	170	J	ND	-	2400	-
SAMP47	3-OCT-2001	130	J	ND	-	2000	-
SAMM48	3-OCT-2001	600	-	110	J	4800	-
SAMP49	3-OCT-2001	1600	-	230	J	2900	-
SAMP50	3-OCT-2001	340	-	87	J	80	J
SAMP54	3-OCT-2001	1500	-	950	-	6800	-
SAM54DUP	3-OCT-2001	2700	-	810	-	5500	-
SAMP55	3-OCT-2001	3200	-	500	-	2200	-
SAMP56	3-OCT-2001	1700	-	350	-	9100	-
SAM56DUP	3-OCT-2001	1200	-	ND	-	7800	-
SAM56DRR	3-OCT-2001	1400	-	ND	-	7900	-
SAMP57	3-OCT-2001	1600	-	270	-	830	-
SAMP58	3-OCT-2001	960	-	100	J	480	-
SAMP59	3-OCT-2001	280	J	300	-	85	J
SAMP60	3-OCT-2001	3800	-	ND	-	1700	-
SAMP61	3-OCT-2001	14000	-	ND	-	12000	-
SAM61DUP	3-OCT-2001	15000	-	ND	-	13000	-
SAMP62	3-OCT-2001	820	-	320	-	120	J
SAMP63	3-OCT-2001	610	-	ND	-	4700	-
SAMP64	3-OCT-2001	13000	-	ND	-	16000	-
SAMP65	3-OCT-2001	300	J	ND	-	830	-
SAMP66	3-OCT-2001	320	J	710	-	530	-
SAMP67	3-OCT-2001	300	J	650	-	290	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

	Zn	As	Pb
Minimum Detection Limit (MDL) =	102	72	41
Minimum Quantitation Limit (MQL)=	339	240	135

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: American Fork Canyon, Orem, Utah
Units: ppm

Sample Code	Date Run	Zn	Qual	As	Qual	Pb	Qual
SAMP68	3-OCT-2001	1200	-	ND	-	4400	-
SAMP69	3-OCT-2001	870	-	470	-	160	-
SAMP70	3-OCT-2001	150	J	150	J	660	-
SAMP71	3-OCT-2001	820	-	ND	-	2200	-
SAMP72	3-OCT-2001	660	-	420	-	1200	-
SAMP73	3-OCT-2001	1500	-	ND	-	630	-
SAMP74	3-OCT-2001	1200	-	150	J	3300	-
SAMP75	3-OCT-2001	2300	-	ND	-	9800	-
SAM75DUP	3-OCT-2001	3000	-	ND	-	11000	-
SAMP76	3-OCT-2001	1700	-	ND	-	4800	-
SAMP77	3-OCT-2001	450	-	ND	-	4900	-
SAMP78	3-OCT-2001	870	-	ND	-	4600	-
SAMP79	3-OCT-2001	1100	-	ND	-	4900	-
SAMP80	3-OCT-2001	630	-	ND	-	5600	-
SAMP81	3-OCT-2001	360	-	ND	-	3900	-
SAMP82	3-OCT-2001	670	-	ND	-	4000	-
SAMP83	3-OCT-2001	350	-	ND	-	1600	-
SAMP84	3-OCT-2001	190	J	160	J	2700	-
SAMP85	3-OCT-2001	ND	-	ND	-	3000	-
SAMP86	3-OCT-2001	140	J	120	J	900	-
SAM86DUP	3-OCT-2001	ND	-	ND	-	900	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

	Zn	As	Pb
Minimum Detection Limit (MDL) =	102	72	41
Minimum Quantitation Limit (MQL)=	339	240	135

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: American Fork Canyon, Orem, Utah
Units: ppm

Sample Code	Date Run	Zn	Qual	As	Qual	Pb	Qual
SAMP87	4-OCT-2001	1100	-	ND	-	2100	-
SAMP88	4-OCT-2001	1500	-	380	-	430	-
SAMP89	4-OCT-2001	220	J	ND	-	ND	-
SAMP90	4-OCT-2001	370	-	87	J	210	-
SAMP91	4-OCT-2001	1900	-	ND	-	4500	-
SAM91DUP	4-OCT-2001	2200	-	ND	-	4700	-
SAMP92	4-OCT-2001	1900	-	240	-	3600	-
SAMP93	4-OCT-2001	3400	-	270	-	4200	-
SAM93DUP	4-OCT-2001	2600	-	230	J	4000	-
SAMP9-1	4-OCT-2001	470	-	810	-	3000	-
SAMP9-2	4-OCT-2001	6100	-	ND	-	18000	-
SAMP9-3	4-OCT-2001	5900	-	ND	-	14000	-
SAMP9-4	4-OCT-2001	430	-	740	-	360	-
SAMP11-1	4-OCT-2001	ND	-	110	J	800	-
SAMP11-2	4-OCT-2001	ND	-	ND	-	1000	-
S94-SUR	4-OCT-2001	21000	-	ND	-	4800	-
SAMP95	4-OCT-2001	140	J	ND	-	45	J
SAMP96	4-OCT-2001	650	-	ND	-	1900	-
SAMP96-1	4-OCT-2001	210	J	89	J	110	J
SAMP97	4-OCT-2001	2400	-	ND	-	8700	-
SAMP98	4-OCT-2001	560	-	ND	-	330	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

	Zn	As	Pb
Minimum Detection Limit (MDL) =	102	72	41
Minimum Quantitation Limit (MQL)=	339	240	135

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Yankee Mine Site
REAC Work Assignment #R1A00232
Spectrace 9000 XRF Soil Screening

Site Name: Orem, Utah
Units: ppm

Sample Code	Date Run	Pb Raw	Pb Qual	
	Time: 2-O	1148.00	1100	-
SAMP1	2-OCT-2001	797.98	800	-
SAMP1DUP	2-OCT-2001	613.45	610	-
SAMP2	2-OCT-2001	4292.76	4300	-
SAMP2RR	2-OCT-2001	4451.86	4500	-
SAMP2DUP	2-OCT-2001	5008.29	5000	-
SAMP3	2-OCT-2001	2089.69	2100	-
SAM3DUP1	2-OCT-2001	2216.74	2200	-
SAM3DUP2	2-OCT-2001	2029.25	2000	-
SAMP4	2-OCT-2001	8843.44	8800	-
SAMP4DUP	2-OCT-2001	8257.95	8300	-
SAMP5	2-OCT-2001	4188.49	4200	-
SAMP5DUP	2-OCT-2001	3633.67	3600	-
SAMP6	2-OCT-2001	1693.30	1700	-
SAMP6DUP	2-OCT-2001	1753.00	1800	-
SAMP7	2-OCT-2001	7247.29	7200	-
SAMP7DUP	2-OCT-2001	7245.51	7200	-
SAMP8	2-OCT-2001	87.51	88	J
SAMP8DUP	2-OCT-2001	98.04	98	J
SAMP9	2-OCT-2001	475.46	480	-
SAMP9DUP	2-OCT-2001	467.26	470	-
SAMP10	2-OCT-2001	1565.22	1600	-
SAM10DUP	2-OCT-2001	1350.51	1400	-
SAMP11	2-OCT-2001	1631.43	1600	-
SAM11DUP	2-OCT-2001	1897.09	1900	-
SAMP12	2-OCT-2001	521.23	520	-
SAMP13	2-OCT-2001	1147.67	1100	-

Application:SOILS with U,Th,Ag Q011 07-08-1992

		Pb
Minimum Detection Limit (MDL)	=	41
Minimum Quantitation Limit (MQL)	=	137

ND = below MDL
J = above MDL, below MQL
NOTE: Draft results, no QA/QC evaluations performed. All XRF data are subject to change.

Appendix C
Copies of Field Logbook Entries
FPXRF Final Trip Report
Yankee Mine Site
Unita National Forest, Utah
August 2002

Daem V+Ab
10/2/01 Unit Q-011 60/60/60 see Cd/Am/Fe

SPECTRACE 9000 FPXRF DAILY INSTRUMENT CHECKOUT

DATE 10/2/01 SPECTRACE SERIAL NO Q-011

SITE Yankee Mine WA# 232

ENERGY CALIBRATION CHECK (SAFETY SHIELD IN PLACE) 60/60/60

#ECK1002

Source: Cd 109		Range
Pb Lα	10.549	KeV(10.50 - 10.58)
Pb Lβ	12.617	KeV(12.57 - 12.65)
Source Line	22.099	KeV(22.06 - 22.14)

Source: Fe55		Range
S Kα	2.3027	KeV(2.29 - 2.33)
Source Line	5.8677	KeV(5.87 - 5.91)

Source: Am 241		Range
Pb Lα	10.536	KeV(10.49 - 10.59)
Pb Lβ	12.640	KeV(12.56 - 12.66)
Source Line	59.520	KeV(59.3 - 59.7)

#ICK1002

IRON Kα RESOLUTION/INTENSITY CHECK (Cd 109, IRON PURE) 60/60/60

Iron at maximum peak height (MPH) = ~~874~~ 2671 counts (MPH ≥ 1000 at 6.40 ± 0.02 KeV) 6412.6
1/2 MPH = 1336 counts

left (low energy) side, 1/2 MPH			right (high energy) side, 1/2 MPH		
1500	counts at	6.2672 KeV 6.2591	1511	counts at	6.5256 KeV 6.5337
1317	counts at	6.2510 KeV	1315	counts at	6.5418 KeV

Calculated FWHM = 0.2746 KeV (≤ 0.300)

☑ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.25 KeV

☑ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.55 Kev

Cd 109 Intensity Check		Criteria
Fe	1.00123	(≥0.95 and ≤1.05)
Mn	0.0001122374	(≤ ± 0.006)
Co	-0.0037924	(≤ ± 0.006)

#Sand01

BLANK SAMPLE CHECK 60/60/60

Check One: ☐ Quartz ☐ Teflon ☒ Sand ☐ Other (Specify) _____

☑ Pass ☐ Fail: All target elements Cr (z=24) and higher are within ± 3 std. deviations of zero

☐ Pass ☐ Fail: All non-target elements Cr (z=24) and higher are within ± 5 std. deviations of zero *

Comments Zr > 50, all >

NOTE: All acquisition times ≥60 seconds each source, All checks with standard Soil Application

Initials LRR

Continued on Page 32

Read and Understood By

Signed	Date	Signed	Date
	10/2/01		

32
PROJECT Yankee Mine WR# 231

Notebook No. _____
Continued From Page 31

XRF	Unit (done)	Q-011 ← PPm (ug/g)	60/60/60 sec = Cd/Zn/Pb →		@ 10 mesh screened
Sample	time	Zn	Cd	Pb	Comments
#sand 1	1219	12	39	-16.5	QC - Blank
#sand 2	1224	-21	14	-11.2	" "
# 2709	1229	160	91	-19	QC-SRM
# 2710	1234	5320	170	4240	"
# 2710	1239	5430	340	4270	"
# 2711	1243	299	78	967	"
Samp 1	1249	626	152	798	Location #1
Samp 1 DUP	1255	784	153	613	dup Loc #1
Samp 2	1259	5390	240	4290	Location #2
Samp 2 RR	1304	1881	43	4450	Recon Loc #2
Samp 2 DUP	1309	1946	140	5010	dup Loc #2
Samp 3	1313	532	-12	2090	Location #3
Sam 3 DUP1	1319	830	-45	2217	dup #3; 1st
Sam-3 DUP2	1323	516	58	2029	dup Loc #3; 2nd
Samp 4	1328	4670	-550	8840	Location #4
Samp 4 DUP	1334	5390	-220	8260	Dup Loc #4
Samp 5	1338	1794	-440	4190	Location #5
Samp 5 DUP	1343	1932	-280	3634	dup Loc #5
# 2709	1348	145	14	8.4	QC - SRM
#R33	1352	73	293	257	"
RR33	1403	23	32K	276	" DL
Samp 6	1409	885	-11	1693	Location #6
Samp 6 DUP	1414	995	-77	1753	dup Loc #6
Samp 7	1418	2560	-430	7250	Location #7
Samp 7 DUP	1423	2990	-360	7250	dup Loc #7
Samp 8	1428	202	6.0	88	Location #8
Samp 8 DUP	1432	198	-15	98	dup Loc #8
Samp 9	1437	416	153	475	Location #9
Samp 9 DUP	1442	242	143	467	dup Loc #9
#2711	1246	314	-14	960	QC-SRM

Changed out battery pack

high copper 10600

note: dup = duplicate XRF cup taken from same sample jar (2 cups)
RR = reanalysis of same XRF sample cup, repositioned (1 cup)

51, 52, 53

Continued on Page 33

Read and Understood By

Signed	Date	Signed	Date
[signature]	10/2/01		

XRF unit Q-011 60/60/60 sec each, 10 mm spaced

Sample	time	Zn	As	Pb	Comments
Samp 10	1452	2760	91	1565	Location #10
Samp 10 dup	1639	2560	178	1351	dup Loc #10
Samp 11	1648	92	-38	1631	Location #11
Samp 11 DUP	1652	105	-72	1897	dup Loc #11
Samp 12	~~1820~~ 1652	~~543~~ 1830	~~527~~ 543	521	Location #12
Samp 13	1704	290	59	1148	Location #13
	yankee-3 → all results downloaded				
file: yankee_4 → all spectra downloaded					
Samp 14	1731	991	215	870	Location #14
Samp 15	1735	603	104	178	Location #15
Samp 16	1740	679	147	317	Location 16
Samp 17	1745	560	88	1984	Location 17
Samp 18	1750	7480	-14	6140	Location #18
Samp 18 dup	1802	6780	-220	5440	Loc #18, dup
Samp 19	1807	164	101	1143	Location #19
Samp 20	1813	2060	-99	4630	Location #20
#2709	1818	181	37	-22	QC-SRM
#2710	1822	6340	56	4920	QC-SRM
#2711	1826	522	8.2	1045	QC-SRM
#R33	1831	120	281	270	QC-SRM
#SAND	1835	153	-8.0	19	QC-SRM BLANK
#2709	1840	328	60	14	QC-SRM
#2709	1844	371	89	-7.2	QC-SRM
#2709	2048	170	33	4.0	QC-SRM
#2709	2054	151	34	5.0	QC-SRM
#2709	2057	85	63	-22	QC-SRM
#2709	2103	183	81	4.8	QC-SRM
#2709	2108	162	43	3.7	QC-SRM
#R33	2112	0.9	234	351	QC-SRM
#2710	2117	5830	200	4670	QC-SRM
2711	2122	321	31	1020	QC-SRM
#SAND	2128	-7.6	-15	1.9	QC-BLANK
MDL (3.5, n=8) →		93	79	41	
MQL (10.5, n=8) →		311	264	137	

Continued on Page

download files: yankee_5 → spectra; yankee_6 → results in <XRF_mine>
ym_10026.res, .spt in <RES123>

Signed _____ Date 10/2/01 Signed _____ Date _____

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PROJECT Yankee Mine WA# 232 Notebook No. _____
Continued From Page 33

XRF via	Q-011	60/60/60 sec	Cd/Am/Fe
#Sample	Zn	As	Pb
#Sand	-19	10	-7.7

SPECTRACE 9000 FPXRF DAILY INSTRUMENT CHECKOUT

DATE 10/3/01 SPECTRACE SERIAL NO Q-011

SITE Yankee Mine WA# WA# 232

60/60/60 sec each

ENERGY CALIBRATION CHECK (SAFETY SHIELD IN PLACE)

#ECK1003

Source: Cd 109		Range
Pb Lα	10.544	KeV(10.50 - 10.58)
Pb Lβ	12.627	KeV(12.57 - 12.65)
Source Line	22.106	KeV(22.06 - 22.14)

Source: Fe55		Range
S Kα	2.3099	KeV(2.29 - 2.33)
Source Line	5.8733	KeV(5.87 - 5.91)

Source: Am 241		Range
Pb Lα	10.532	KeV(10.49 - 10.59)
Pb Lβ	12.635	KeV(12.56 - 12.66)
Source Line	59.494	KeV(59.3 - 59.7)

IRON Kα RESOLUTION/INTENSITY CHECK (Cd 109, IRON PURE)

#ICK1003

Iron at maximum peak height (MPH) = 6.3918 → 2739 counts (MPH ≥ 1000 at 6.40 ± 0.02 KeV)

1/2 MPH = 1369 counts

left (low energy) side, 1/2 MPH			right (high energy) side, 1/2 MPH		
1368	counts at	6.2627 KeV	1294	counts at	6.5371 KeV
1639	counts at	6.2788 KeV	1506	counts at	6.5209 KeV

6.7075 6.5290

Calculated FWHM = 0.1785 KeV (≤ 0.300)

☒ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.25 KeV

☒ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.55 Kev

#Sand

Cd 109 Intensity Check		Criteria
Fe	0.990239	(≥0.95 and ≤1.05)
Mn	0.001 29094	(≤ ± 0.006)
Co	-0.000107888	(≤ ± 0.006)

Ba = 47790

BLANK SAMPLE CHECK

Check One: ☐ Quartz ☐ Teflon ☒ Sand ☐ Other (Specify) _____

☐ Pass ☐ Fail: All target elements Cr (z=24) and higher are within ± 3 std. deviations of zero (#)

☐ Pass ☐ Fail: All non-target elements Cr (z=24) and higher are within ± 5 std. deviations of zero (##)

Comments (#) Zr 36.8 / 3.20, As 1.6 / 17.16

NOTE: All acquisition times ≥60 seconds each source, All checks with standard Soil Application

Rev - 03/14/01 Initials _____

Continued on Page 35

Read and Understood By

Signed _____ Date 10/3/01

Signed _____ Date _____

XRF via Q-011 60/60/60

Sample	Zn	As	Pb	Comments
#Samp	-19	10	-7.7	QC-BLANK
# 2709	119	38	-16	QC-SRM
#2709	191	7.6	6.7	QC-SRM
#2710	6070	340	4850	QC-SRM
#2711	374	40	982	QC-SRM
#R33	12	338	304	QC-SRM
	←	ppm (ug/g)	→	
Sample	(start) time Zn	As	Pb	Comments
Samp 21	0949 88	29	262	Location 21
Samp 22	0953 333	131	1160	Location 22
Samp 23	0958 1003	353	1740	Location #23
SAM 23 DUP	1003 618	191	1689	dup Loc #23
Samp 24	1008 511	-78	2085	Location # 24
Samp 25	1013 1084	390	4550	" #25
Samp 26	1017 734	-215	2561	" #26
Samp 51	1022 1135	-62	1121	" #51
SAM 51 DUP	1027 1082	-167	1140	dup Loc # 51
SAMP 52	1031 2100	-440	2611	Location 52
SAM 52 DUP	1037 2260	-323	2390	dup Loc # 52
Samp 53	1042 418	30	229	Location # 53
SAM 53 DUP	1048 424	-26	282	dup Loc # 53
#2709	1052 92	60	-15	QC-SRM
SAMP 27	1057 1198	61	917	Location # 27
Samp 28	1101 8750	-460	13370	Location 28
SAM 28 DUP	1107 10590	-370	15350	dup Loc # 28
Samp 29	1112 28290	-33	16250	Location # 29
Samp 30	1126 1336	368	1566	" # 30
Samp 32	1131 11170	-730	13860	" # 32
SAMP 33	1135 196	651	1219	" # 33
Samp 34	1140 680	410	2213	" 34
Samp 35	1147 2760	600	3960	" 35
SAMP 36	1153 3600	39	3690	Location # 36
#2709	1159 181	24	-25	QC-SRM

Continued on Page 36

Read and Understood By

Signed _____ Date 10/3/01 Signed _____ Date _____

XRF via Q-011, 60 sec read, 10 mesh screened

Yankee Rhne Site

Sample	Time	← ppm (ug/g) → Zn	As	Pb	Comments
Samp 38	1204	254	101	1420	
Sam 39 Dup	1209	650	160	3820	
Samp 40	1215	2750	-120	2618	
Samp dup	1220	156	131	668	

files: Yn_1003a → downloaded spectra via Hyperterm
Yn_1003b → downloaded results via Hyperterm
Yn_1003a.RES " " " " via get.exe
Yn_1003a.SPT " " Spectra " " "

Samp 31	1258	790	340	2728	mostly organics
Samp 37	1253	1732	350	2167	Location #37
Samp 42	1257	121	-128	2412	" " 42
Samp 43	1308	126	173	692	" " 43
Samp 43 Dup	1366	312	129	872	dup Loc# 43
Samp 44	1321	310	1562	409	Location # 44
Samp 45	1326	764	235	915	" " 45
Samp 46	1332	172	-39	2376	" " 46
Samp 47	1337	131	-151	2045	" " 47
Samp 48	1341	601	110	4760	" " 48
#2709	1346	142	70	4:1	QC-SRM
Samp 49	1350	16720	230	2940	Location #49
Samp 50	1355	339	87	-29	50
Samp 54	1400	1460	950	6800	54
Sam 54 dup	1405	2730	810	5460	dup, Loc # 54
Samp 55	1410	3200	500	2237	Location 55
Samp 56	1414	1750	350	9080	56
Samp 56 dup	1420	1180	-94	7790	
Samp 56 DRR	1425	1350	-67	7900	rerun of dup Loc #56
#2709	1430	118	46	10	

Continued on Page 37

Read and Understood By

Signed _____ Date 10/7/01 Signed _____ Date _____

XRF	via	$-on$	60 sec each	, 40 mesh	sieved	
sample		time	Zn	As	Pb	comments
Samp	57	1434	1598	272	827	Location #5
"	58	1439	964	100	476	58
"	59	1443	285	30	85	59
"	60	1448	3790	24	1667	60
"	61	1453	14320	-650	11890	61
SAM 61	DUP	1458	15150	-940	13350	
Samp	62	1503	816	319	123	
"	63	1508	609	-39	4670	
"	64	1513	13250	-360	16160	
"	65	1518	297	-58	832	
"	66	1523	323	711	534	
"	67	1527	298	647	285	
"	68	1531	1215	31	4360	
"	69	1536	872	469	157	
"	70	1542	154	152	656	
#2709		1547	137	-78	-9.6	QC-SRM
Samp	71	1553	825	-61	2185	
"	72	1600	659	420	1175	
"	73	1609	1491	-124	629	
"	74	1614	1250	150	3270	
"	75	1619	2310	-1010	9790	
Samp	75 DUP	1625	2980	-1100	10710	
Samp	76	1629	1730	-200	4770	
"	77	1634	448	-560	4890	
"	78	1639	869	-430	4650	
"	79	1645	1091	-420	4920	
"	80	1650	627	-510	5580	
#2709		1655				QC-SRM

Spectra saving

Note: results stored but not spectra stored from Samp 31 to Samp 80 even though the store spectra option was selected

#2709	1705	190	47	

Continued on Page 38

Read and Understood By

Signed	Date	Signed	Date
[signature]	10/3/01		

XRF via 9-10, 60 sec each, 10 mesh sieved

ppm (ug/g)

Sample	time	Zn	As	Pb	Comments to Location
Samp 81	1716	359	1.2 48 NR	3940	81
Samp 82	1722	670	-7.4	4020	82
Samp 83	1727	352	-41	1587	83
Samp 84	1733	189	160	2660	84
Samp 85	1737	59	-350	3039	85
Samp 86	1741	138	124	895	Location # 86
SAM 86 DUP	1746	63	31	899	dup Loc # 86
#2709	1800	188	515	-19	QC - SRM
#2710	1806	6270	120	4880	
#2711	1812	284	68	986	
#SAND	1817	25	8.8	-10.1	
#R33	1822	58	270	295	

get program results → ym_10036.res, ym_1003c.res
spectra → ym_10036.spt

QC - SRM concentrations:

	Zn	As	Pb	
2709	106	17.7	18.9	
2710	6952	626	5532	
2711	350.4	105	1162	
R33	NA	273	528	(Cr = 1431)

Continued on Page

Read and Understood By

Signed _____ Date 10/2/01

Signed _____ Date _____

XRF Q-011 @ 60 sec each, 10 mesh sieved

81
82
83
84
85
86
87
M

SPECTRACE 9000 FPXRF DAILY INSTRUMENT CHECKOUT

DATE 10/4/01 SPECTRACE SERIAL NO Q-011

SITE Yankee Mine WA# 232

60/60/60

ENERGY CALIBRATION CHECK (SAFETY SHIELD IN PLACE)

ECK1004

Source: Cd 109		Range
Pb Lα	10.542	KeV(10.50 - 10.58)
Pb Lβ	12.624	KeV(12.57 - 12.65)
Source Line	22.100	KeV(22.06 - 22.14)

Source: Fe55		Range
S Kα	2.297	KeV(2.29 - 2.33)
Source Line	5.8972	KeV(5.87 - 5.91)

Source: Am 241		Range
Pb Lα	10.529	KeV(10.49 - 10.59)
Pb Lβ	12.632	KeV(12.56 - 12.66)
Source Line	59.479	KeV(59.3 - 59.7)

IRON Kα RESOLUTION/INTENSITY CHECK (Cd 109, IRON PURE)

ICK1004

Iron at maximum peak height (MPH) = 2613 counts (MPH ≥ 1000 at 6.40 ± 0.02 KeV) 6.4060

1/2 MPH = 1307 counts

left (low energy) side, 1/2 MPH

1487 counts at 6.2608 KeV
1212 counts at 6.2447 KeV } 6.25275

right (high energy) side, 1/2 MPH

1567 counts at 6.5190 KeV
1285 counts at 6.5351 KeV } 6.52705

Calculated FWHM = 0.2743 KeV (≤ 0.300)

☑ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.25 KeV

☑ Pass ☐ Fail: Counts ≤ 1/2 MPH at 6.55 Kev

Cd 109 Intensity Check		Criteria
Fe	1.00282	(≥0.95 and ≤1.05)
Mn	-0.000798	(≤ ± 0.006)
Co	-0.0019228	(≤ ± 0.006)

BLANK SAMPLE CHECK

SAND

Check One: ☐ Quartz ☐ Teflon ☒ Sand ☐ Other (Specify) _____

☑ Pass ☐ Fail: All target elements Cr (z=24) and higher are within ± 3 std. deviations of zero

☐ Pass ☐ Fail: All non-target elements Cr (z=24) and higher are within ± 5 std. deviations of zero

Comments Zn > 5σ

NOTE: All acquisition times ≥60 seconds each source, All checks with standard Soil Application

Initials JBT

Rev - 03/14/01

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Read and Understood By

Signed JBT Date 10/4/01 Signed _____ Date _____

1431

XRF @ bocce each, Q-01, 10 mesh sieved

Sample	time	Zn	As	Pb	comments
# Samp	0858	19	-48	-2.4	QC BLANK
#2709	0903	121	45	-25	QC-SRM
#2709	0909	127	77	1.9	
#2710	0913	6360	386	4890	
#2711	0918	234	42	1063	
#R33	0923	-71	337	329	
#R33	0928	22	295	302	
SAMP 87	0935	1140	-213	2077	Location #87
Samp 88	0940	1524	382	428	88
Samp 89	0945	215	9.7	13	89
SAMP 90	0949	366	87	207	90
SAMP 91	0954	1927	-440	4490	Location 91
SAM 91 DUP	0959	2220	-150	4680	duplock# 91
Samp 92	1005	1854	240	3617	Location #92
SAMP 93	1011	3380	270	4180	" " 93
SAM 93 DUP	1016	2610	230	3970	dup Loc# 93
SAMP 9-1	1020	469	810	2975	Loc #9, 1'
#2709	1025	145	14	0.02	QC-SRM
SAMP 9-2	1030	6120	-780	17590	Loc#9, 2'
SAMP 9-3	1035	5930	-450	13680	Loc#9, 3'
SAMP 9-4	1042	426	-739	357	Loc#9, 4'
SAMP 11-1	1047	53	108	805	Loc#11 1'
SAMP 11-2	1052	74	-156	1000	Loc#11 2'
S94-SUR	1055	21090 #	-770	4780	Loc #94, surface wet
SAMP 95	1108	139	50	45	Location 95
SAMP 96	1105	649	-117	1941	Location 96
SAMP 96-1	1116	207	89	110	Loc#96, 1'
SAMP 97	1120	2370	-480	8730	Location #97
SAMP 98	1125	555	53	326	Location #98
#2709-98RR	1130	502	98	371	QC-SRM 98RR
#2709	1146	198	62	53	

results downloaded via get → ym-1004.Res

Continued on Page 41

Read and Understood By

Signed _____ Date 10/4/01

Signed _____ Date _____

XRF Q-011, 60 sec @ each

← ug/g →

sample	time	Zn	As	Pb	Comments
#2709	1151	97	72	17	QC-SRM
#2710	1157	6120	-136	5100	"
#2711	1203	330	-29	1069	"
#SAND	1207	33	-17	6.9	QC-BLANK
#R33	1220	14	286	253	QC SRM
#R33		14	269	274	"

Spectra downloaded via Jet → ym-1004.spt

AC powered

Continued on Page

Read and Understood By

Signed _____ Date 10/04/01 Signed _____ Date _____

Appendix C

Appendix C
Final Analytical Report
Yankee Mine Site
Unita National Forest, Utah
August 2002

Lockheed Martin Technology Services
Environmental Services REAC
2890 Woodbridge Avenue Building 209 Annex
Edison, NJ 08837-3679
Telephone 732-321-4200 Facsimile 732-494-4021

LOCKHEED MARTIN

DATE: 17 December 2001

TO: R. Singhvi EPA/ERTC

FROM: D. Miller Analytical Section Leader D Miller

SUBJECT: DOCUMENT TRANSMITTAL UNDER WORK ASSIGNMENT # 0-232

Attached please find the following document prepared under this work assignment:

Yankee Mine - Analytical Report

Central File WA # 0-232	(w/attachment)
A. Humphrey	Work Assignment Manager (w/attachment)
S. Grossman	Task Leader (w/attachment)
J. Soroka	Data Validation and Report Writing Group Leader (w/o attachment)

0232\DEL\AR\1201\REPORT

ANALYTICAL REPORT

Prepared by
LOCKHEED MARTIN, Inc.

Yankee Mine
New York

December 2001

EPA Work Assignment No. 0-232
LOCKHEED MARTIN Work Order R1A00232
EPA Contract No. 68-C99-223

Submitted to
A. Humphrey
EPA-ERTC

S. Grossman — Date 12/13/01
Task Leader

D. Miller — Date 12/20/01
Analytical Section Leader

S. Clapp — Date 12/20/01
Program Manager

Analysis by:
REAC

Prepared by:
G. Karustis

Reviewed by:
J. Soroka

0232\DEL\AR\1201\REPORT

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Appendices will be furnished on request.

Introduction

REAC in response to WA 0-232, provided analytical support for environmental samples collected from Yankee Mine, located in New York as described in the following table. The support also included QA/QC, data review, and preparation of an analytical report containing a summary of the analytical methods, the results, and the QA/QC results.

The samples were treated with procedures consistent with those specified in SOP #1008.

COC #	Number of Samples	Sampling Date	Date Received	Matrix	Analysis	Laboratory	Data Package
00358	16	10/3/01	10/9/01	Water	Metals	REAC	K 371
00536	9	10/1/01	10/9/01	Soil	Metals	REAC	K 369
00536	10	10/2/01	10/9/01	Soil	Metals	REAC	K 369
00537	7	10/3/01	10/9/01	Soil	Metals	REAC	K 368
00537	1	10/2/01	10/9/01	Soil	Metals	REAC	K 368
00537	1	10/4/01	10/9/01	Soil	Metals	REAC	K 368

The samples were received in XRF cups. Percent moistures were not determined due to the small sample size.

Case Narrative

The data in this report have been validated to two significant figures. Any other representation of the data is the responsibility of the user.

Metals in Water Package K 371

The acceptable QC limits for the percent recovery were exceeded for lead in sample A 04460 MSD (59%). The results of the lead analysis for the associated samples A 04454 through A 04460 should be regarded as estimated.

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Metals in Soil Package K 369

The acceptable QC limits for the percent recoveries of antimony, barium and selenium were exceeded as tabulated below.

	B 03607 MS	B 03607 MSD
Antimony	22	1
Barium	Acceptable	297
Selenium	127	Acceptable

	B 03616 MS	B 03616 MSD
Antimony	Acceptable	37
Selenium	21	13

The data are affected as follows:

The results of the antimony analysis for samples B 03601 through B 03616, B 03619 and B 03620 should be regarded as estimated.

The results of the selenium analysis for samples B 03601 through B 03603, B 03608, B 03609, B 03612 throuthB 03616 and B 03619 should be regarded as estimated.

The results of the barium analysis for samples B 03601 through B 03607 should be regarded as estimated.

Metals in Soil Package K 368

The acceptable QC limits for the percent recoveries of antimony and zinc were exceeded as tabulated below.

	B 03625 MS	B 03625 MSD
Antimony	23	27
Zinc	632	Acceptable

The data are affected as follows:

The results of the antimony analysis for samples B 03622 through B 03625 should be regarded as estimated.

The results of the barium analysis for samples B 03621 through B 03628 should be regarded as estimated.

Summary of Abbreviations

AA	Atomic Absorption
B	The analyte was found in the blank
BFB	Bromofluorobenzene
C	Centigrade
cont.	Continued
D	(Surrogate Table) this value is from a diluted sample and was not calculated (Result Table) this result was obtained from a diluted sample
Dioxin and/or PCDD and PCDF	denotes Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans
CLP	Contract Laboratory Protocol
COC	Chain of Custody
CONC	Concentration
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limit
E	The value is greater than the highest linear standard and is estimated
EMPC	Estimated maximum possible concentration
ICAP	Inductively Coupled Argon Plasma
ISTD	Internal Standard
J	The value is below the method detection limit and is estimated
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
MI	Matrix Interference
MS (BS)	Matrix Spike (Blank Spike)
MSD (BSD)	Matrix Spike Duplicate (Blank Spike Duplicate)
MW	Molecular Weight
NA	either Not Applicable or Not Available
NC	Not Calculated
NR	Not Requested
NS	Not Spiked
% D	Percent Difference
% REC	Percent Recovery
PPB	Parts per billion
PPBV	Parts per billion by volume
PPMV	Parts per million by volume
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selected Ion Monitoring
TCLP	Toxic Characteristics Leaching Procedure
U	Denotes not detected
W	Weathered analyte; Aroclor pattern displays a degradation of earlier eluting peaks

m^3	cubic meter	kg	kilogram	μg	microgram
L	liter	g	gram	pg	picogram
mL	milliliter	mg	milligram	ng	nanogram
μL	microliter				

*	denotes a value that exceeds the acceptable QC limit
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Revision 7/26/01

ANALYTICAL REPORT

Prepared by
LOCKHEED MARTIN, Inc.

Yankee Mine
New York

December 2001

EPA Work Assignment No. 0-232
LOCKHEED MARTIN Work Order R1A00232
EPA Contract No. 68-C99-223

Submitted to
A. Humphrey
EPA-ERTC

12/18/01
S. Grossman — Date
Task Leader

12/20/01
D. Miller — Date
Analytical Section Leader

12/26/01
S. Clapp — Date
Program Manager

Analysis by:
REAC

Prepared by:
G. Karustis

Reviewed by:
J. Soroka

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REAC in response to WA 0-232, provided analytical support for environmental samples collected from Yankee Mine, located in New York as described in the following table. The support also included QA/QC, data review, and preparation of an analytical report containing a summary of the analytical methods, the results, and the QA/QC results.

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00536	10	10/2/01	10/9/01	Soil	Metals	REAC	K 369
00537	7	10/3/01	10/9/01	Soil	Metals	REAC	K 368
00537	1	10/2/01	10/9/01	Soil	Metals	REAC	K 368
00537	1	10/4/01	10/9/01	Soil	Metals	REAC	K 368

The samples were received in XRF cups. Percent moistures were not determined due to the small sample size.

Case Narrative

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Metals in Water Package K 371

The acceptable QC limits for the percent recovery were exceeded for lead in sample A 04460 MSD (59%). The results of the lead analysis for the associated samples A 04454 through A 04460 should be regarded as estimated.

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Metals in Soil Package K 369

The acceptable QC limits for the percent recoveries of antimony, barium and selenium were exceeded as tabulated below.

	B 03607 MS	B 03607 MSD
Antimony	22	1
Barium	Acceptable	297
Selenium	127	Acceptable

	B 03616 MS	B 03616 MSD
Antimony	Acceptable	37
Selenium	21	13

The data are affected as follows:

The results of the antimony analysis for samples B 03601 through B 03616, B 03619 and B 03620 should be regarded as estimated.

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The results of the barium analysis for samples B 03601 through B 03607 should be regarded as estimated.

Metals in Soil Package K 368

The acceptable QC limits for the percent recoveries of antimony and zinc were exceeded as tabulated below.

	B 03625 MS	B 03625 MSD
Antimony	23	27
Zinc	632	Acceptable

The data are affected as follows:

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Summary of Abbreviations

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COC	Chain of Custody
CONC	Concentration
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limit
E	The value is greater than the highest linear standard and is estimated
EMPC	Estimated maximum possible concentration
ICAP	Inductively Coupled Argon Plasma
ISTD	Internal Standard
J	The value is below the method detection limit and is estimated
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
MI	Matrix Interference
MS (BS)	Matrix Spike (Blank Spike)
MSD (BSD)	Matrix Spike Duplicate (Blank Spike Duplicate)
MW	Molecular Weight
NA	either Not Applicable or Not Available
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NS	Not Spiked
% D	Percent Difference
% REC	Percent Recovery
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PPMV	Parts per million by volume
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QL	Quantitation Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selected Ion Monitoring
TCLP	Toxic Characteristics Leaching Procedure
U	Denotes not detected
W	Weathered analyte; Aroclor pattern displays a degradation of earlier eluting peaks

m^3	cubic meter	kg	kilogram	μg	microgram
L	liter	g	gram	pg	picogram
mL	milliliter	mg	milligram	ng	nanogram
μL	microliter				

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Revision 7/26/01

ANALYTICAL REPORT

Prepared by
LOCKHEED MARTIN, Inc.

Yankee Mine
New York

December 2001

EPA Work Assignment No. 0-232
LOCKHEED MARTIN Work Order R1A00232
EPA Contract No. 68-C99-223

Submitted to
A. Humphrey
EPA-ERTC

S. Grossman — 12/13/01
Task Leader — Date

D. Miller — 12/20/01
Analytical Section Leader — Date

S. Clapp — 12/26/01
Program Manager — Date

Analysis by:
REAC

Prepared by:
G. Karustis

Reviewed by:
J. Soroka

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00537	1	10/2/01	10/9/01	Soil	Metals	REAC	K 368
00537	1	10/4/01	10/9/01	Soil	Metals	REAC	K 368

The samples were received in XRF cups. Percent moistures were not determined due to the small sample size.

Case Narrative

The data in this report have been validated to two significant figures. Any other representation of the data is the responsibility of the user.

Metals in Water Package K 371

The acceptable QC limits for the percent recovery were exceeded for lead in sample A 04460 MSD (59%). The results of the lead analysis for the associated samples A 04454 through A 04460 should be regarded as estimated.

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Metals in Soil Package K 369

The acceptable QC limits for the percent recoveries of antimony, barium and selenium were exceeded as tabulated below.

	B 03607 MS	B 03607 MSD
Antimony	22	1
Barium	Acceptable	297
Selenium	127	Acceptable

	B 03616 MS	B 03616 MSD
Antimony	Acceptable	37
Selenium	21	13

The data are affected as follows:

The results of the antimony analysis for samples B 03601 through B 03616, B 03619 and B 03620 should be regarded as estimated.

The results of the selenium analysis for samples B 03601 through B 03603, B 03608, B 03609, B 03612 throuthB 03616 and B 03619 should be regarded as estimated.

The results of the barium analysis for samples B 03601 through B 03607 should be regarded as estimated.

Metals in Soil Package K 368

The acceptable QC limits for the percent recoveries of antimony and zinc were exceeded as tabulated below.

	B 03625 MS	B 03625 MSD
Antimony	23	27
Zinc	632	Acceptable

The data are affected as follows:

The results of the antimony analysis for samples B 03622 through B 03625 should be regarded as estimated.

The results of the barium analysis for samples B 03621 through B 03628 should be regarded as estimated.

Summary of Abbreviations

AA	Atomic Absorption
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BFB	Bromofluorobenzene
C	Centigrade
cont.	Continued
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Dioxin and/or PCDD and PCDF	denotes Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans
CLP	Contract Laboratory Protocol
COC	Chain of Custody
CONC	Concentration
CRDL	Contract Required Detection Limit
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E	The value is greater than the highest linear standard and is estimated
EMPC	Estimated maximum possible concentration
ICAP	Inductively Coupled Argon Plasma
ISTD	Internal Standard
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LCS	Laboratory Control Sample
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MI	Matrix Interference
MS (BS)	Matrix Spike (Blank Spike)
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MW	Molecular Weight
NA	either Not Applicable or Not Available
NC	Not Calculated
NR	Not Requested
NS	Not Spiked
% D	Percent Difference
% REC	Percent Recovery
PPB	Parts per billion
PPBV	Parts per billion by volume
PPMV	Parts per million by volume
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selected Ion Monitoring
TCLP	Toxic Characteristics Leaching Procedure
U	Denotes not detected
W	Weathered analyte; Aroclor pattern displays a degradation of earlier eluting peaks

m^3	cubic meter	kg	kilogram	μg	microgram
L	liter	g	gram	pg	picogram
mL	milliliter	mg	milligram	ng	nanogram
μL	microliter				

* denotes a value that exceeds the acceptable QC limit

Abbreviations that are specific to a particular table are explained in footnotes on that table

Revision 7/26/01

ANALYTICAL REPORT

Prepared by
LOCKHEED MARTIN, Inc.

Yankee Mine
New York

December 2001

EPA Work Assignment No. 0-232
LOCKHEED MARTIN Work Order R1A00232
EPA Contract No. 68-C99-223

Submitted to
A. Humphrey
EPA-ERTC

12/18/01
S. Grossman — Date
Task Leader

12/20/01
D. Miller — Date
Analytical Section Leader

12/26/01
S. Clapp — Date
Program Manager

Analysis by:
REAC

Prepared by:
G. Karustis

Reviewed by:
J. Soroka

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00537	1	10/4/01	10/9/01	Soil	Metals	REAC	K 368

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Case Narrative

The data in this report have been validated to two significant figures. Any other representation of the data is the responsibility of the user.

Metals in Water Package K 371

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0232\DEL\AR\1201\REPORT

Metals in Soil Package K 369

The acceptable QC limits for the percent recoveries of antimony, barium and selenium were exceeded as tabulated below.

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Metals in Soil Package K 368

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Summary of Abbreviations

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C	Centigrade
cont.	Continued
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Task Leader

D. Miller — Date 12/20/01
Analytical Section Leader

S. Clapp — Date 12/26/01
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Metals in Water Package K 371

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Selenium	21	13

The data are affected as follows:

The results of the antimony analysis for samples B 03601 through B 03616, B 03619 and B 03620 should be regarded as estimated.

The results of the selenium analysis for samples B 03601 through B 03603, B 03608, B 03609, B 03612 throuthB 03616 and B 03619 should be regarded as estimated.

The results of the barium analysis for samples B 03601 through B 03607 should be regarded as estimated.

Metals in Soil Package K 368

The acceptable QC limits for the percent recoveries of antimony and zinc were exceeded as tabulated below.

	B 03625 MS	B 03625 MSD
Antimony	23	27
Zinc	632	Acceptable

The data are affected as follows:

The results of the antimony analysis for samples B 03622 through B 03625 should be regarded as estimated.

The results of the barium analysis for samples B 03621 through B 03628 should be regarded as estimated.

Summary of Abbreviations

AA	Atomic Absorption
B	The analyte was found in the blank
BFB	Bromofluorobenzene
C	Centigrade
cont.	Continued
D	(Surrogate Table) this value is from a diluted sample and was not calculated (Result Table) this result was obtained from a diluted sample
Dioxin and/or PCDD and PCDF	denotes Polychlorinated Dibenzo-p-dioxins and Polychlorinated Dibenzofurans
CLP	Contract Laboratory Protocol
COC	Chain of Custody
CONC	Concentration
CRDL	Contract Required Detection Limit
CRQL	Contract Required Quantitation Limit
DFTPP	Decafluorotriphenylphosphine
DL	Detection Limit
E	The value is greater than the highest linear standard and is estimated
EMPC	Estimated maximum possible concentration
ICAP	Inductively Coupled Argon Plasma
ISTD	Internal Standard
J	The value is below the method detection limit and is estimated
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MDL	Method Detection Limit
MI	Matrix Interference
MS (BS)	Matrix Spike (Blank Spike)
MSD (BSD)	Matrix Spike Duplicate (Blank Spike Duplicate)
MW	Molecular Weight
NA	either Not Applicable or Not Available
NC	Not Calculated
NR	Not Requested
NS	Not Spiked
% D	Percent Difference
% REC	Percent Recovery
PPB	Parts per billion
PPBV	Parts per billion by volume
PPMV	Parts per million by volume
PQL	Practical Quantitation Limit
QA/QC	Quality Assurance/Quality Control
QL	Quantitation Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SIM	Selected Ion Monitoring
TCLP	Toxic Characteristics Leaching Procedure
U	Denotes not detected
W	Weathered analyte; Aroclor pattern displays a degradation of earlier eluting peaks

m^3	cubic meter	kg	kilogram	μg	microgram
L	liter	g	gram	pg	picogram
mL	milliliter	mg	milligram	ng	nanogram
μL	microliter				

* denotes a value that exceeds the acceptable QC limit

Abbreviations that are specific to a particular table are explained in footnotes on that table

Revision 7/26/01

Analytical Procedure for Metals in Water

Sample Preparation

A representative 45 mL aliquot of each sample was mixed with 5.0-mL concentrated nitric acid, placed in an acid rinsed Teflon container, capped with a Teflon lined cap, and digested according to SW-846, method 3015 in a CEM MDS-2100 microwave oven, which was programmed to bring the samples to 160 +/- 4°C in 10 minutes (first stage) and slowly to 165-170°C in the second 10 minutes (second stage). After digestion, the samples were allowed to cool to room temperature and were transferred to acid cleaned bottles. The samples were analyzed for all metals, except mercury, by US EPA SW-846, method 7000 Atomic Absorption (AA) or method 6010 Inductively Coupled Argon Plasma (ICAP) procedures.

A 100 mL aliquot of each sample was transferred to a 300-mL BOD bottle and prepared according to SW-846, method 7470. The samples were heated for 2 hours on a hot plate at 95° C, cooled to room temperature and reduced with hydroxylamine hydrochloride (NH_2OH:HCl). Mercury was then analyzed separately on a Leeman Labs PS200II AA Spectrometer.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each analytical batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) sample were also processed for each analytical batch or every 10 samples.

Analysis and Calculations

The AA, ICAP and Leeman Labs PS200II instruments were calibrated and operated according to SW-846, method 7000/7470/6010 and the manufacturer's operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB), and QC check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) standards were run after every 10 samples to verify proper operation during sample analysis.

The metal concentration in solution, in micrograms per liter (mg/L), was read directly from the read-out system of the instrument. ICAP and mercury results were taken directly from instrument read-outs. The ICAP results were corrected for digestion volume (45-mL sample + 5-mL nitric acid) prior to instrument read-out; AA read-outs (excluding mercury) were externally corrected for digestion volume (1.1111 * AA read-out).

For samples that required dilution to fall within the instrument calibration range:

$$\text{mg/L metal in sample} = A\,[\,(C+B) / C\,]$$

where:

A = direct read-out (ICAP and mercury)
A = corrected read-out (AA)
B = acid blank matrix used for dilution, mL
C = sample aliquot, mL

Results of the analyses are listed in Table 1.1.

Revision 12/18/00

Analytical Procedure for Metals in Soil

Sample Preparation

A representative 1-2 g (wet weight) sample, weighed to 0.01 g accuracy, was mixed with 10-mL 1:1 nitric acid, placed in a 50-mL polypropylene digestion cup and digested in nitric acid and hydrogen peroxide according to SW-846, Method 3050 B on a Hot Block digestion system. The final reflux was either nitric acid or hydrochloric acid depending on the metals to be determined. After digestion, the samples were allowed to cool to room temperature, transferred to 100 mL volumetric flasks and diluted to volume with ASTM Type II water. The samples were analyzed for all metals, except mercury, by USEPA SW-846, Method 7000 (Atomic absorption) or Method 6010 (Inductively Coupled Argon Plasma-ICAP) procedures.

A representative 0.25-0.8 g (wet weight) sample was transferred to a 300-mL BOD bottle and prepared according to SW-846, Method 7471. The sample was heated for 1/2 hour on a hot plate at 95° C, cooled to room temperature, and reduced with hydroxylamine hydrochloride (NH_2OH:HCl). Mercury was then analyzed separately on a Leeman Labs PS200II AA Spectrometer.

A separate sample was used to determine total solids.

A reagent blank and a blank spike sample were carried through the sample preparation procedure for each batch of samples processed. One matrix spike (MS) and one matrix spike duplicate (MSD) were analyzed for each batch or for every ten samples.

Analysis and Calculations

The AA, ICAP and Leeman Labs PS200II instruments were calibrated and operated according to SW-846, Method 7000/7471/6010 and the manufacturers operating instructions. After calibration, initial calibration verification (ICV), initial calibration blank (ICB) and quality control check standards were run to verify proper calibration. The continuing calibration verification (CCV) and continuing calibration blank (CCB) were run after every ten samples to assure proper operation during sample analysis.

The metal concentration in solution , in micrograms per liter (µg/L) was taken from the read-out system of the Atomic Absorption instrument. The results were converted to milligrams per kilogram (mg/kg) by correcting the reading for the sample weight and percent solids. The ICAP results (mg/kg) were corrected for sample weight prior to instrument read-out; the instrument read-out was then corrected for percent solids.
Final concentrations, based on wet weight are given by:

mg metal/kg sample = [(AxV)/W]xDFxCF

where:

A = Instrument read-out (µg/L, AA; mg/kg, ICAP)
V = final volume of processed sample (mL, AA; 1.00 ICAP)
W = weight of sample (g, AA; 1.00 ICAP)
DF = Dilution Factor (1.00 for no dilution)
CF = conversion factor (0.001, AA; 1.00, ICAP)

For samples that required dilution to be within the instrument calibration range, DF is given by:

DF = (C+B)/C

where:

B = acid blank matrix used for dilution (mL)
C = sample blank aliquot (mL)

Final concentrations, based on dry weight, are given by:

mg/kg(dry) =[mg/kg (wet)x100] /S

where

S = percent solids

The results are listed in Table 1.2.

Revision date: 8/17/2000

Table 1.1 Results of the Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Client ID		Method Blank		A04451		A04452		A04453		A04454		A04455	
Location		Lab		SW-01		SW-01 DUP		SW-02		SW-03		SW-04	
Parameter	Analysis Method	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L
Aluminum	ICAP	U	50	480	50	480	50	U	50	340	50	260	50
Antimony	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Arsenic	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	2.8	2.2	4.0	2.2
Barium	ICAP	U	5.0	23	5.0	23	5.0	61	5.0	79	5.0	24	5.0
Beryllium	ICAP	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0
Cadmium	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Calcium	ICAP	U	100	20000	100	20000	100	37000	100	48000	100	64000	100
Chromium	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Cobalt	ICAP	U	10	U	10	U	10	U	10	U	10	U	10
Copper	ICAP	U	10	44	10	45	10	U	10	U	10	U	10
Iron	ICAP	U	25	37	25	39	25	U	25	400	25	590	25
Lead	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	11	2.2	12	2.2
Magnesium	ICAP	U	500	7700	500	7800	500	19000	500	25000	500	33000	500
Manganese	ICAP	U	5.0	16	5.0	17	5.0	U	5.0	25	5.0	29	5.0
Mercury	Cold Vapor	U	0.20	U	0.20	U	0.20	U	0.20	U	0.20	U	0.20
Nickel	ICAP	U	10	U	10	U	10	U	10	U	10	U	10
Potassium	ICAP	U	2000	U	2000	U	2000	U	2000	U	2000	U	2000
Selenium	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Silver	ICAP	U	5	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Sodium	ICAP	U	500	770	500	750	500	750	500	820	500	900	500
Thallium	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Vanadium	ICAP	U	10	U	10	U	10	U	10	U	10	U	10
Zinc	ICAP	U	10	44	10	44	10	26	10	21	10	34	10

Table 1.1 (cont.) Results of the Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Client ID		A04456		A04457		A04458		A04459		A04460		A04661	
Location		SW-05		SW-06		SW-07		SW-08		SW-09		SW-10	
Parameter	Analysis Method	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L
Aluminum	ICAP	100	50	U	50	140	50	3300	50	1600	50	560	50
Antimony	AA-Fur	2.9	2.2	U	2.2	4.6	2.2	46	2.2	13	2.2	6.5	2.2
Arsenic	AA-Fur	83	2.2	U	2.2	U	2.2	920	11	98	2.2	49	2.2
Barium	ICAP	15	5.0	78	5.0	26	5.0	67	5.0	68	5.0	36	5.0
Beryllium	ICAP	U	2.0	U	2.0	U	2.0	2.3	2.0	U	2.0	U	2.0
Cadmium	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	7.4	5.0	U	5.0
Calcium	ICAP	23000	100	44000	100	24000	100	25000	100	30000	100	29000	100
Chromium	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Cobalt	ICAP	U	10	U	10	U	10	U	10	U	10	U	10
Copper	ICAP	U	10	U	10	12	10	110	10	140	10	37	10
Iron	ICAP	8200	25	77	25	250	25	120000	25	14000	25	5700	25
Lead	AA-Fur	2.9	2.2	5.2	2.2	6.0	2.2	230	2.2	180	2.2	57	2.2
Magnesium	ICAP	8800	500	15000	500	9600	500	9700	500	12000	500	11000	500
Manganese	ICAP	140	5.0	5.2	5.0	19	5.0	200	5.0	110	5.0	79	5.0
Mercury	Cold Vapor	U	0.20	U	0.20	U	0.20	U	0.20	0.28	0.20	U	0.20
Nickel	ICAP	12	10	U	10	U	10	16	10	12	10	U	10
Potassium	ICAP	U	2000	U	2000	U	2000	U	2000	2500	2000	U	2000
Selenium	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Silver	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Sodium	ICAP	880	500	1400	500	770	500	900	500	990	500	870	500
Thallium	AA-Fur	U	2.2	U	2.2	U	2.2	86	2.2	U	2.2	U	2.2
Vanadium	ICAP	U	10	U	10	U	10	U	10	U	10	U	10
Zinc	ICAP	290	10	58	10	160	10	820	10	1000	10	320	10

Table 1.1 (cont.) Results of the Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Client ID		A04462		A04463		A04464		A04465		A04466	
Location		SW-11		SW-12		SEEP 1		SEEP 2		Field Blank	
Parameter	Analysis Method	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L	Conc µg/L	MDL µg/L
Aluminum	ICAP	U	50	520	50	U	50	100	50	U	50
Antimony	AA-Fur	U	2.2	13	2.2	2.8	2.2	U	2.2	U	2.2
Arsenic	AA-Fur	U	2.2	63	2.2	8.4	2.2	U	2.2	U	2.2
Barium	ICAP	39	5.0	32	5.0	150	5.0	66	5.0	U	5.0
Beryllium	ICAP	U	2.0	U	2.0	U	2.0	U	2.0	U	2.0
Cadmium	ICAP	U	5.0	U	5.0	U	5.0	5.0	5.0	U	5.0
Calcium	ICAP	33000	100	27000	100	47000	100	44000	100	U	100
Chromium	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Cobalt	ICAP	U	10	U	10	U	10	U	10	U	10
Copper	ICAP	U	10	47	10	U	10	63	10	U	10
Iron	ICAP	26	25	7300	25	8500	25	99	25	U	25
Lead	AA-Fur	U	2.2	130	2.2	U	2.2	11	2.2	U	2.2
Magnesium	ICAP	11000	500	11000	500	23000	500	22000	500	U	500
Manganese	ICAP	U	5.0	100	5.0	380	5.0	85	5.0	U	5.0
Mercury	Cold Vapor	U	0.20	U	0.20	U	0.20	U	0.20	U	0.20
Nickel	ICAP	U	10	U	10	U	10	U	10	U	10
Potassium	ICAP	U	2000	U	2000	U	2000	U	2000	U	2000
Selenium	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Silver	ICAP	U	5.0	U	5.0	U	5.0	U	5.0	U	5.0
Sodium	ICAP	900	500	850	500	1100	500	840	500	U	500
Thallium	AA-Fur	U	2.2	U	2.2	U	2.2	U	2.2	U	2.2
Vanadium	ICAP	U	10	U	10	U	10	U	10	U	10
Zinc	ICAP	U	10	420	10	670	10	770	10	U	10

Table 1.2 Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		Method Blank		B03601		B03602		B03603		B03604		B03605	
Location		Lab		2		4		7		10		10 DUP	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	U	18	1300	17	1100	17	3600	17	4400	17	4300	17
Antimony	ICAP	U	6.0	330	5.8	210	5.7	370	5.8	69	5.8	83	5.8
Arsenic	ICAP	U	7.5	650	7.3	430	7.1	490	7.3	120	7.2	170	7.3
Barium	ICAP	U	1.0	490	0.97	780	0.95	780	0.97	1000	0.96	840	0.97
Beryllium	ICAP	U	0.50	U	0.49	U	0.48	U	0.49	0.64	0.48	0.62	0.49
Cadmium	ICAP	U	0.50	25	0.49	110	0.48	43	0.49	36	0.48	35	0.49
Calcium	ICAP	U	50	330	49	330	48	350	49	4100	48	3900	49
Chromium	ICAP	U	0.50	1.2	0.49	1.0	0.48	5.8	0.49	6.2	0.48	6.3	0.49
Cobalt	ICAP	U	1.0	U	0.97	1.7	0.95	3.8	0.97	7.1	0.96	7.4	0.97
Copper	ICAP	U	1.0	500	0.97	79	0.95	280	0.97	340	0.96	220	0.97
Iron	ICAP	U	10	28000	9.7	7900	9.5	23000	9.7	23000	9.6	22000	9.7
Lead	ICAP	U	4.0	11000	3.9	16000	3.8	20000	3.9	2600	3.8	2300	3.9
Magnesium	ICAP	U	50	190	49	300	48	1200	49	3000	48	3000	49
Manganese	ICAP	U	1.0	19	0.97	170	0.95	110	0.97	440	0.96	440	0.97
Mercury	Cold Vapor	U	0.04	14	0.38	47	0.8	4.4	0.19	3.7	0.08	2.6	0.08
Nickel	ICAP	U	1.0	U	0.97	1.5	0.95	5.9	0.97	11	0.96	10	0.97
Potassium	ICAP	U	200	1800	190	670	190	1600	190	1400	190	1400	190
Selenium	AA-Fur	U	0.50	7.5	2.5	6.1	2.3	5.0	2.4	U	2.4	U	2.4
Silver	ICAP	U	0.50	33	0.49	62	0.48	46	0.49	13	0.48	13	0.49
Sodium	ICAP	U	50	94	49	U	48	U	49	U	48	U	49
Thallium	AA-Fur	U	0.50	U	2.5	4.6	2.3	U	2.4	U	2.4	U	2.4
Vanadium	ICAP	U	2.0	4.4	1.9	2.0	1.9	8.1	1.9	8.6	1.9	8.3	1.9
Zinc	ICAP	U	2.0	3400	1.9	14000	9.5	5600	1.9	4700	1.9	4700	1.9

Table 1.2 (cont.) Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		B03606		B03607		B03608		B03609		B03610		B03611	
Location		12		14		18		20		23		23 DUP	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	10000	18	7200	18	540	17	6600	18	3400	17	3300	17
Antimony	ICAP	12	5.9	42	6.0	1400	5.7	85	5.9	77	5.8	87	5.8
Arsenic	ICAP	360	7.4	290	7.5	680	7.1	140	7.4	300	7.3	300	7.3
Barium	ICAP	310	0.98	150	1.0	47	0.94	230	0.99	740	0.97	600	0.97
Beryllium	ICAP	1.6	0.49	0.80	0.50	U	0.47	0.55	0.50	U	0.49	U	0.49
Cadmium	ICAP	8.5	0.49	13	0.50	76	0.47	11	0.50	11	0.49	6.7	0.49
Calcium	ICAP	8800	49	6700	50	980	47	7300	50	250	49	210	49
Chromium	ICAP	16	0.49	11	0.50	U	0.47	10	0.50	4.2	0.49	4.0	0.49
Cobalt	ICAP	20	0.98	9.2	1.0	6.1	0.94	9.5	0.99	2.4	0.97	2.6	0.97
Copper	ICAP	280	0.98	1100	1.0	470	0.94	15000	5.0	700	0.97	680	0.97
Iron	ICAP	61000	49	52000	50	130000	47	82000	50	37000	49	39000	49
Lead	ICAP	560	3.9	880	4.0	20000	3.8	4800	4.0	1700	3.9	1800	3.9
Magnesium	ICAP	6300	49	5500	50	180	47	4900	50	800	49	810	49
Manganese	ICAP	1100	0.98	770	1.0	66	0.94	980	0.99	72	0.97	85	0.97
Mercury	Cold Vapor	0.64	0.04	0.52	0.04	39	0.78	2.1	0.08	1.7	0.04	1.1	0.04
Nickel	ICAP	31	0.98	15	1.0	2.5	0.94	17	0.99	4.0	0.97	3.8	0.97
Potassium	ICAP	2500	200	1600	200	700	190	1600	200	1500	190	1400	190
Selenium	AA-Fur	U	2.4	U	2.5	3.0	2.4	3.2	2.5	U	2.5	U	2.5
Silver	ICAP	2.8	0.49	12	0.50	71	0.47	71	0.50	16	0.49	15	0.49
Sodium	ICAP	52	49	U	50	U	47	120	50	63	49	63	49
Thallium	AA-Fur	U	2.4	U	2.5	U	2.4	U	2.5	U	2.5	U	2.5
Vanadium	ICAP	19	2.0	18	2.0	3.7	1.9	14	2.0	8.4	1.9	8.4	1.9
Zinc	ICAP	1500	2.0	1600	2.0	11000	9.5	1500	2.0	1300	1.9	920	1.9

Table 1.2 (cont.) Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		B03612		B03613		B03614		B03615		B03616		B03617	
Location		25		28		29		32		35		44	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	12000	18	670	18	560	17	2300	17	3200	18	3900	17
Antimony	ICAP	54	5.9	1900	5.9	910	5.7	600	5.8	140	5.9	U	5.8
Arsenic	ICAP	400	7.4	370	7.4	280	7.1	270	7.2	1200	7.4	1500	7.3
Barium	ICAP	220	0.99	560	0.99	300	0.94	730	0.96	460	0.99	120	0.97
Beryllium	ICAP	1.1	0.50	U	0.50	U	0.47	U	0.48	1.0	0.50	U	0.49
Cadmium	ICAP	6.1	0.50	160	0.50	470	0.47	160	0.48	36	0.50	4.8	0.49
Calcium	ICAP	1400	50	240	50	U	47	140	48	11000	50	2000	49
Chromium	ICAP	13	0.50	U	0.50	U	0.47	3.1	0.48	3.7	0.50	5.6	0.49
Cobalt	ICAP	10	0.99	U	0.99	U	0.94	1.5	0.96	5.4	0.99	1.7	0.97
Copper	ICAP	2300	0.99	330	0.99	340	0.94	310	0.96	890	0.99	67	0.97
Iron	ICAP	59000	50	12000	9.9	15000	9.4	18000	9.6	60000	50	58000	49
Lead	ICAP	3800	4.0	32000	20	21000	3.8	17000	3.8	5200	4.0	340	3.9
Magnesium	ICAP	2600	50	250	50	73	47	680	48	6200	50	490	49
Manganese	ICAP	340	0.99	82	0.99	460	0.94	120	0.96	280	0.99	20	0.97
Mercury	Cold Vapor	1.7	0.04	51	1.6	67	1.6	35	0.75	4.2	0.19	0.26	0.04
Nickel	ICAP	21	0.99	U	0.99	U	0.94	2.1	0.96	11	0.99	7.8	0.97
Potassium	ICAP	1800	200	650	200	850	190	1100	190	1800	200	6300	190
Selenium	AA-Fur	2.5	2.5	5.0	2.5	4.2	2.4	5.6	2.5	6.4	2.4	U	2.5
Silver	ICAP	16	0.50	160	0.50	180	0.47	75	0.48	28	2.5	1.5	0.49
Sodium	ICAP	U	50	U	50	U	47	U	48	53	50	84	49
Thallium	AA-Fur	U	2.5	U	2.5	U	2.4	U	2.5	U	2.4	U	2.5
Vanadium	ICAP	20	2.0	U	2.0	2.0	1.9	7.0	1.9	5.2	2.0	7.7	1.9
Zinc	ICAP	1100	2.0	23000	9.9	59000	9.5	21000	9.6	4400	2.0	160	1.9

Table 1.2 (cont.) Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		B03618		B03619		B03620	
Location		50		54		54 DUP	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	11000	18	1900	17	1700	17
Antimony	ICAP	U	5.9	130	5.8	780	5.8
Arsenic	ICAP	43	7.4	820	7.2	820	7.3
Barium	ICAP	86	0.98	110	0.96	110	0.97
Beryllium	ICAP	1.6	0.49	U	0.48	U	0.49
Cadmium	ICAP	1.1	0.49	51	0.48	38	0.49
Calcium	ICAP	27000	49	1200	48	1300	49
Chromium	ICAP	18	0.49	2.0	0.48	1.8	0.49
Cobalt	ICAP	12	0.98	1.9	0.96	2.6	0.97
Copper	ICAP	50	0.98	760	0.96	1500	0.97
Iron	ICAP	22000	9.8	97000	48	93000	49
Lead	ICAP	86	3.9	21000	3.8	25000	3.9
Magnesium	ICAP	10000	49	610	48	630	49
Manganese	ICAP	420	0.98	72	0.96	58	0.97
Mercury	Cold Vapor	0.34	0.04	4.8	0.18	5.4	0.19
Nickel	ICAP	21	0.98	3.5	0.96	3.6	0.97
Potassium	ICAP	3500	200	2200	190	2100	190
Selenium	AA-Fur	U	2.5	3.5	2.4	U	2.4
Silver	ICAP	0.69	0.49	64	0.48	92	0.49
Sodium	ICAP	U	49	U	48	U	49
Thallium	AA-Fur	U	2.5	2.8	2.4	U	2.4
Vanadium	ICAP	16	2.0	7.3	1.9	6.9	1.9
Zinc	ICAP	240	2.0	6700	1.9	5100	1.9

Table 1.2 (cont.) Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		Method Blank		B03621		B03622		B03623		B03624		B03625	
Location		Lab		59		61		64		75		86	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	U	18	4000	17	850	17	2200	18	1600	18	1600	18
Antimony	ICAP	U	6.0	U	5.8	2800	5.8	1500	5.9	150	5.9	U	5.9
Arsenic	ICAP	U	7.5	230	7.2	560	7.3	520	7.4	160	7.4	81	7.4
Barium	ICAP	U	1.0	160	0.96	5.5	0.97	160	0.99	60	0.98	45	0.99
Beryllium	ICAP	U	0.50	1.8	0.48	U	0.49	0.81	0.50	U	0.49	U	0.50
Cadmium	ICAP	U	0.50	1.4	0.48	220	0.49	210	0.50	47	0.49	U	0.50
Calcium	ICAP	U	50	49000	48	100000	240	44000	50	1900	49	210	50
Chromium	ICAP	U	0.50	6.9	0.48	3.1	0.49	9.5	0.50	1.6	0.49	1.4	0.50
Cobalt	ICAP	U	1.0	16	0.96	7.2	0.97	7.7	0.99	U	0.98	U	0.99
Copper	ICAP	U	1.0	36	0.96	3000	0.97	3600	0.99	1600	0.98	37	0.99
Iron	ICAP	U	10	23000	9.6	42000	49	55000	50	61000	49	11000	9.9
Lead	ICAP	U	4.0	95	3.8	95000	19	23000	4.0	30000	3.9	930	4.0
Magnesium	ICAP	U	50	22000	48	56000	49	26000	50	470	49	180	50
Manganese	ICAP	U	1.0	710	0.96	1500	0.97	320	0.99	16	0.98	14	0.99
Mercury	Cold Vapor	U	0.04	0.15	0.05	3.0	0.36	32	0.98	2.1	0.05	0.3	0.05
Nickel	ICAP	U	1.0	35	0.96	11	0.97	36	0.99	U	0.98	U	0.99
Potassium	ICAP	U	200	2600	190	U	190	1100	200	1300	200	1900	200
Selenium	AA-Fur	U	0.50	U	2.3	4.7	2.3	U	2.5	U	2.3	U	2.4
Silver	ICAP	U	0.50	0.64	0.48	430	0.49	69	0.50	120	0.49	6.2	0.50
Sodium	ICAP	U	50	74	48	U	49	76	50	U	49	U	50
Thallium	AA-Fur	U	0.50	1.1	0.92	U	0.93	U	0.98	U	0.93	U	0.96
Vanadium	ICAP	U	2.0	6.9	1.9	5.0	1.9	10	2.0	3.7	2.0	U	2.0
Zinc	ICAP	U	2.0	190	1.9	29000	9.7	20000	9.9	5700	9.8	46	2.0

Table 1.2 (cont.) Results of the Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results Based on Samples as Received

Client ID		B03626		B03627		B03628	
Location		97		9-2'		9-4'	
Parameter	Analysis Method	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg	Conc mg/kg	MDL mg/kg
Aluminum	ICAP	10000	18	760	17	7400	17
Antimony	ICAP	150	5.9	250	5.6	6.0	5.7
Arsenic	ICAP	300	7.4	660	6.9	560	7.1
Barium	ICAP	800	0.98	510	0.93	220	0.94
Beryllium	ICAP	0.73	0.49	U	0.46	U	0.47
Cadmium	ICAP	20	0.49	100	0.46	2.6	0.47
Calcium	ICAP	14000	49	190	46	170	47
Chromium	ICAP	15	0.49	0.47	0.46	10	0.47
Cobalt	ICAP	5.2	0.98	U	0.93	4.4	0.94
Copper	ICAP	550	0.98	990	0.93	170	0.94
Iron	ICAP	17000	9.8	31000	46	31000	47
Lead	ICAP	11000	3.9	41000	19	310	3.8
Magnesium	ICAP	2700	49	110	46	2400	47
Manganese	ICAP	250	0.98	64	0.93	280	0.94
Mercury	Cold Vapor	4.7	0.50	72	2.0	0.42	0.04
Nickel	ICAP	8.0	0.98	U	0.93	9.2	0.94
Potassium	ICAP	940	200	1600	190	2500	190
Selenium	AA-Fur	U	2.5	U	2.3	U	2.4
Silver	ICAP	49	0.49	140	0.46	1.3	0.47
Sodium	ICAP	1900	49	U	46	150	47
Thallium	AA-Fur	U	0.99	U	0.93	U	0.97
Vanadium	ICAP	18	2.0	2.4	1.9	29	1.9
Zinc	ICAP	2600	2.0	13000	9.3	360	1.9

Results of the QC Standard Analysis for Metals in Water

QC standards QC-21x100, QC-7x100, ERA-438, TMAA #1, TMAA #2 and SDWA-3034 were used to check the accuracy of the calibration curve. The percent recoveries, listed in Table 2.1, ranged from 83 to 109 and all nineteen recovered concentrations for which 95% confidence limits are available were within these limits. 95% Confidence limits are not available for seventeen values.

Results of the MS/MSD Analysis for Metals in Water

Samples A 04460 and A 04465 were chosen for the matrix spike/matrix spike duplicate analysis (MS/MSD). The percent recoveries, listed in Table 2.2, ranged from 59 to 104 and seventy-two out of seventy-four calculated values were within the acceptable QC limits. Two other values were not calculated because the concentration of analyte in the sample was greater than four times the concentration spiked. The relative percent differences, also listed in Table 2.2, ranged from 0 (zero) to 31 and thirty-six out of thirty-seven calculated values were within the acceptable QC limits. One other value was not calculated because the concentration of analyte in the sample was greater than four times the concentration spiked.

Results of the Blank Spike Analysis for Metals in Water

The results of the blank spike analysis are reported in Table 2.3. The percent recoveries ranged from 93 to 104 and all twenty-three values were within the acceptable QC limits.

Results of the LCS Analysis for Metals in Water

LCS standard 99104 was also analyzed. The percent recoveries, listed in Table 2.4, ranged from 83 to 101 and all nineteen percent recoveries were within the 95% confidence limits.

Table 2.1 Results of the QC Standard Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	Quality Control Standard	Conc. Rec µg/L	Certified Value µg/L	95% Confidence Interval µg/L	% Rec
Aluminum	10/25/01	QC-7 x100	1003	1000	NA	100
	10/25/01	ERA-438	587	558	458 - 658	105
Antimony	10/25/01	TMAA#2	59.14	60	38.07 - 69.71	99
Arsenic	11/02/01	TMAA #1	41.46	40	32.45 - 46.55	104
Barium	10/25/01	QC-7 x100	1010	1000	NA	101
	10/25/01	ERA-438	588	583	478 - 688	101
Beryllium	10/25/01	QC-21 x100	1029	1000	NA	103
	10/25/01	ERA-438	99.5	95.8	78.6 - 113	104
Cadmium	10/25/01	QC-21 x100	1024	1000	NA	102
	10/25/01	ERA-438	76.7	75	61.5 - 88.5	102
Calcium	10/25/01	QC-21 x100	1028	1000	NA	103
Chromium	10/25/01	QC-21 x100	1043	1000	NA	104
	10/25/01	ERA-438	542	517	424 - 610	105
Cobalt	10/25/01	QC-21 x100	1061	1000	NA	106
	10/25/01	ERA-438	226	208	171 - 245	109
Copper	10/25/01	QC-21 x100	1022	1000	NA	102
	10/25/01	ERA-438	198	192	157 - 227	103
Iron	10/25/01	QC-21 x100	1049	1000	NA	105
	10/25/01	ERA-438	913	867	711 - 1020	105
Lead	10/25/01	TMAA#1	84.1	80	68.98 - 91.16	105
Magnesium	10/25/01	QC-21 x100	963	1000	NA	96
Manganese	10/25/01	QC-21 x100	1044	1000	NA	104
	10/25/01	ERA-438	177	171	140 - 202	104
Mercury	10/26/01	SDWA-3034	3.15	3.8	2.66-4.94	83
Nickel	10/25/01	QC-21 x100	1065	1000	NA	107
	10/25/01	ERA-438	197	187	153 - 221	105
Potassium	10/25/01	QC-7 x100	8961	10000	NA	90
Selenium	10/25/01	TMAA #1	81.1	80	65.38 - 88.47	101
Silver	10/25/01	QC-7 x100	1033	1000	NA	103
	10/25/01	ERA-438	77.1	77.5	63.6 - 91.5	99
Sodium	10/25/01	QC-7 x100	993	1000	NA	99
Thallium	10/24/01	TMAA #2	60.84	60	50.19 - 68.32	101
Vanadium	10/25/01	QC-21 x100	1008	1000	NA	101
	10/25/01	ERA-438	185	192	157 - 227	96
Zinc	10/25/01	QC-21 x100	1034	1000	NA	103
	10/25/01	ERA-438	471	454	372 - 536	104

Table 2.2 Results of the MS/MSD Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Sample ID: A04460

Metal	Sample Conc µg/L	MS Spike Added µg/L	MS Conc µg/L	MS % Rec	MSD Spike Added µg/L	MSD Conc µg/L	MSD % Rec		RPD		Recommended QC Limits % Rec	RPD
Aluminum	1570	2222	3528	88	2222	3167	72	*	20		75-125	20
Antimony	13.2	55.6	64.6	93	55.6	65.7	95		2		75-125	20
Arsenic	97.7	55.6	141	78	55.6	139	75		5		75-125	20
Barium	67.6	222	282	96	222	280	96		1		75-125	20
Beryllium	U	222	210	95	222	210	95		0		75-125	20
Cadmium	7.4	222	207	90	222	207	90		0		75-125	20
Chromium	U	222	211	95	222	210	95		0		75-125	20
Cobalt	U	222	209	94	222	207	93		1		75-125	20
Copper	142	222	349	93	222	353	95		2		75-125	20
Iron	13690	2222	15400	NC	2222	15290	NC		NC		75-125	20
Lead	178	55.6	223	81	55.6	211	59	*	31	*	75-125	20
Manganese	109	222	314	92	222	312	91		1		75-125	20
Mercury	0.276	2.00	2.29	101	2.00	2.21	97		4		75-125	20
Nickel	12.1	222	213	90	222	215	91		1		75-125	20
Selenium	U	55.6	46.4	84	55.6	46.2	83		0		75-125	20
Silver	U	222	198	89	222	201	90		2		75-125	20
Thallium	U	55.6	57.4	103	55.6	57.8	104		1		75-125	20
Vanadium	U	222	211	95	222	213	96		1		75-125	20
Zinc	1013	222	1200	84	222	1187	78		7		75-125	20

Table 2.2 (cont.) Results of the MS/MSD Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Sample ID: A04465

Metal	Sample Conc µg/L	MS Spike Added µg/L	MS Conc µg/L	MS % Rec	MSD Spike Added µg/L	MSD Conc µg/L	MSD % Rec	RPD	Recommended QC Limits % Rec	RPD
Aluminum	103	2222	2184	94	2222	2208	95	1	75-125	20
Antimony	U	55.6	55.9	101	55.6	57.2	103	2	75-125	20
Arsenic	U	55.6	53.4	96	55.6	53.3	96	0	75-125	20
Barium	65.7	222	279	96	222	282	97	1	75-125	20
Beryllium	U	222	209	94	222	211	95	1	75-125	20
Cadmium	5	222	209	92	222	207	91	1	75-125	20
Chromium	U	222	213	96	222	214	96	0	75-125	20
Cobalt	U	222	212	95	222	213	96	0	75-125	20
Copper	62.9	222	275	95	222	280	98	2	75-125	20
Iron	99.3	2222	2221	95	2222	2247	97	1	75-125	20
Lead	10.8	55.6	59.7	88	55.6	59.2	87	1	75-125	20
Manganese	84.7	222	292	93	222	295	95	1	75-125	20
Mercury	U	2.00	1.87	94	2.00	1.91	96	2	75-125	20
Nickel	U	222	222	100	222	216	97	3	75-125	20
Selenium	U	55.6	46	83	55.6	45	81	2	75-125	20
Silver	U	222	203	91	222	205	92	1	75-125	20
Thallium	U	55.6	56.4	102	55.6	55.1	99	2	75-125	20
Vanadium	U	222	215	97	222	216	97	0	75-125	20
Zinc	765	222	960	88	222	967	91	4	75-125	20

Table 2.3 Results of the Blank Spike Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Metal	Spiked Conc. µg/L	Rec Conc. µg/L	% Rec	Recommended QC Limits %Rec
Aluminum	2222	2075	93	75-125
Antimony	55.6	55.3	100	75-125
Arsenic	55.6	54.7	98	75-125
Barium	222	213	96	75-125
Beryllium	222	211	95	75-125
Cadmium	222	207	93	75-125
Calcium	2222	2108	95	75-125
Chromium	222	218	98	75-125
Cobalt	222	218	98	75-125
Copper	222	214	96	75-125
Iron	2222	2174	98	75-125
Lead	55.6	56	101	75-125
Magnesium	2222	2057	93	75-125
Manganese	222	214	96	75-125
Mercury	2.00	1.96	98	75-125
Nickel	222	219	99	75-125
Potassium	8889	8407	95	75-125
Selenium	55.6	57.6	104	75-125
Silver	222	208	94	75-125
Sodium	2222	2085	94	75-125
Thallium	55.6	54	97	75-125
Vanadium	222	216	97	75-125
Zinc	222	209	94	75-125

Table 2.4 Results of the LCS Analysis for Metals in Water
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	LCS Standard (ERA Lot#)	Conc. Rec µg/L	Certified Value µg/L	PALs µg/L	% Rec
Aluminum	10/25/01	99104	1077	1120	918 - 1320	96
Antimony	10/25/01	99104	175	183	137 - 229	96
Arsenic	11/02/01	99104	281	295	221 - 348	95
Barium	10/25/01	99104	959	975	800 - 1150	98
Beryllium	10/25/01	99104	560	572	469 - 675	98
Cadmium	10/25/01	99104	455	508	417 - 599	90
Chromium	10/25/01	99104	889	902	740 - 1060	99
Cobalt	10/25/01	99104	237	240	197 - 283	99
Copper	10/25/01	99104	634	643	527 - 759	99
Iron	10/25/01	99104	428	445	365 - 525	96
Lead	10/25/01	99104	298	296	243 - 349	101
Manganese	10/25/01	99104	1482	1520	1250 - 1790	98
Mercury	10/26/01	99104	13.5	16.3	12.2 - 20.4	83
Nickel	10/25/01	99104	1755	1790	1470 - 2210	98
Selenium	10/25/01	99104	1250	1400	1050 - 1650	89
Silver	10/25/01	99104	541	578	474 - 682	94
Thallium	10/24/01	99104	573	610	458 - 720	94
Vanadium	10/25/01	99104	1395	1420	1160 - 1680	98
Zinc	10/25/01	99104	788	843	691 - 995	93

Results of the QC Standard Analysis for Metals in Soil

QC standards QC-21x100, QC-7x100, ERA-438, TMAA #1, TMAA #2 and SDWA-3034 were used to check the accuracy of the calibration curve. The percent recoveries, listed in Table 2.5, ranged from 97 to 111 and all thirty-six recovered concentrations for which 95% confidence are available were within these limits. 95% Confidence limits are not available for thirty-eight values.

Results of the MS/MSD Analysis for Metals in Soil

Samples B 03607, B 03616 and B 03625 were chosen for the matrix spike/matrix spike duplicate analysis (MS/MSD). The percent recoveries, listed in Table 2.6, ranged from 1 to 632 and sixty-six out of seventy-six calculated values were within the acceptable QC limits. Twenty-six other values were not calculated because the concentration of analyte in the sample was greater than four times the concentration spiked. The relative percent differences, also listed in Table 2.6, ranged from 0 (zero) to 148 and thirty-one out of thirty-eight calculated values were within the acceptable QC limits. Thirteen other values were not calculated because the concentration of analyte in the sample was greater than four times the concentration spiked.

Results of the Blank Spike Analysis for Metals in Soil

The results of the blank spike analysis are reported in Table 2.7. The percent recoveries ranged from 86 to 112 and all forty-six values were within the acceptable QC limits.

Results of the LCS Analysis for Metals in Soil

LCS standard 248 was also analyzed. The percent recoveries, listed in Table 2.8, ranged from 40 to 108 and all forty-six percent recoveries were within the 95% confidence limits.

Table 2.5 Results of the QC Standard Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	Quality Control Standard	Conc. Rec µg/L	Certified Value µg/L	95% Confidence Interval µg/L	% Rec
Aluminum	10/18/01	QC-7 x100	1020	1000	NA	102
	10/18/01	ERA-438	610	558	458 - 658	109
Antimony	10/18/01	QC-21 x100	1027	1000	NA	103
Arsenic	10/18/01	QC-21 x100	1014	1000	NA	101
Barium	10/18/01	QC-7 x100	1005	1000	NA	100
	10/18/01	ERA-438	581	583	478 - 688	100
Beryllium	10/18/01	QC-21 x100	1038	1000	NA	104
	10/18/01	ERA-438	100	95.8	78.6 - 113	104
Cadmium	10/18/01	QC-21 x100	1020	1000	NA	102
	10/18/01	ERA-438	78	75	61.5 - 88.5	104
Calcium	10/18/01	QC-21 x100	1028	1000	NA	103
Chromium	10/18/01	QC-21 x100	1053	1000	NA	105
	10/18/01	ERA-438	545	517	424 - 610	105
Cobalt	10/18/01	QC-21 x100	1072	1000	NA	107
	10/18/01	ERA-438	231	208	171 - 245	111
Copper	10/18/01	QC-21 x100	1033	1000	NA	103
	10/18/01	ERA-438	198	192	157 - 227	103
Iron	10/18/01	QC-21 x100	1083	1000	NA	108
	10/18/01	ERA-438	943	867	711 - 1020	109
Lead	10/18/01	QC-21 x100	1053	1000	NA	105
	10/18/01	ERA-438	308	292	239 - 345	105
Magnesium	10/18/01	QC-21 x100	996	1000	NA	100
Manganese	10/18/01	QC-21 x100	1053	1000	NA	105
	10/18/01	ERA-438	179	171	140 - 202	105
Mercury	10/10/01	SDWA-3042	3.13	3.18	2.23 - 4.13	98
Nickel	10/18/01	QC-21 x100	1087	1000	NA	109
	10/18/01	ERA-438	201	187	153 - 221	107
Potassium	10/18/01	QC-7 x100	10020	10000	NA	100
Selenium	10/24/01	TMAA #1	80.2	80	65.38 - 88.47	100
Silver	10/18/01	QC-7 x100	1032	1000	NA	103
	10/18/01	ERA-438	80	77.5	63.6 - 91.5	103
Sodium	10/18/01	QC-7 x100	1010	1000	NA	101
Thallium	10/24/01	TMAA #2	64.09	60	50.19 - 68.32	107
Vanadium	10/18/01	QC-21 x100	1033	1000	NA	103
	10/18/01	ERA-438	193	192	157 - 227	101
Zinc	10/18/01	QC-21 x100	1040	1000	NA	104
	10/18/01	ERA-438	475	454	372 - 536	105

Table 2.5 (cont.) Results of the QC Standard Analysis for Metals (Soil)
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	Quality Control Standard	Conc. Rec µg/L	Certified Value µg/L	95% Confidence Interval µg/L	% Rec
Aluminum	10/17/01	QC-7 x100	1019	1000	NA	102
	10/17/01	ERA-438	618	558	458 - 658	111
Antimony	10/17/01	QC-21 x100	1012	1000	81.7 - 125	101
Arsenic	10/17/01	QC-21 x100	1034	1000	81.7 - 125	103
Barium	10/17/01	QC-7 x100	1011	1000	NA	101
		ERA-438	581	583	478 - 688	100
Beryllium	10/17/01	QC-21 x100	1030	1000	NA	103
	10/17/01	ERA-438	99	95.8	78.6 - 113	103
Cadmium	10/17/01	QC-21 x100	1018	1000	NA	102
	10/17/01	ERA-438	79	75	61.5 - 88.5	105
Calcium	10/17/01	QC-21 x100	1028	1000	NA	103
Chromium	10/17/01	QC-21 x100	1049	1000	NA	105
	10/17/01	ERA-438	547	517	424 - 610	106
Cobalt	10/17/01	QC-21 x100	1075	1000	NA	108
	10/17/01	ERA-438	231	208	171 - 245	111
Copper	10/17/01	QC-21 x100	1025	1000	NA	102
	10/17/01	ERA-438	199	192	157 - 227	104
Iron	10/17/01	QC-21 x100	1070	1000	NA	107
	10/17/01	ERA-438	935	867	711 - 1020	108
Lead	10/17/01	QC-21 x100	1049	1000	NA	105
	10/17/01	ERA-438	316	292	239 - 345	108
Magnesium	10/17/01	QC-21 x100	987	1000	NA	99
Manganese	10/17/01	QC-21 x100	1049	1000	NA	105
	10/17/01	ERA-438	177	171	140 - 202	104
Mercury	10/12/01	SDWA-3042	3.08	3.18	2.23 - 4.13	97
Nickel	10/17/01	QC-21 x100	1073	1000	NA	107
	10/17/01	ERA-438	205	187	153 - 221	110
Potassium	10/17/01	QC-7 x100	9816	10000	NA	98
Selenium	10/23/01	TMAA #1	81.5	80	65.38 - 88.47	102
Silver	10/17/01	QC-7 x100	1025	1000	NA	102
	10/17/01	ERA-438	81	77.5	63.6 - 91.5	105
Sodium	10/17/01	QC-7 x100	1019	1000	NA	102
Thallium	10/23/01	TMAA #2	63.36	60	50.19 - 68.32	106
Vanadium	10/17/01	QC-21 x100	1025	1000	NA	102
	10/17/01	ERA-438	195	192	157 - 227	102
Zinc	10/17/01	QC-21 x100	1034	1000	NA	103
	10/17/01	ERA-438	469	454	372 - 536	103

Table 2.6 Results of the MS/MSD Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results based on as received weight

Sample ID:	B03607										
Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec		MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec		RPD		Recommended QC Limits %Rec	RPD
Antimony	41.9	49.5	52.6	22	*	48.1	42.2	1	*	98	*	75-125	20
Arsenic-ICAP	287	49.5	297	NC		48.1	302	NC		NC		75-125	20
Barium	150	49.5	207	115		48.1	293	297	*	88	*	75-125	20
Beryllium	0.8	49.5	49.3	98		48.1	47.7	98		0		75-125	20
Cadmium	13	49.5	52.7	80		48.1	50	77		4		75-125	20
Chromium	11.4	49.5	59	96		48.1	56	93		4		75-125	20
Cobalt	9.16	49.5	55.2	93		48.1	53.2	92		2		75-125	20
Copper	1053	49.5	918	NC		48.1	1241	NC		NC		75-125	20
Lead	884	49.5	903	NC		48.1	1141	NC		NC		75-125	20
Manganese	772	49.5	813	NC		48.1	821	NC		NC		75-125	20
Mercury	0.518	0.400	0.964	111		0.400	0.894	94		17		75-125	20
Nickel	14.6	49.5	61	94		48.1	58.5	91		3		75-125	20
Selenium	U	5.00	6.35	127	*	4.95	6.04	122		4		75-125	20
Silver	11.7	49.5	57.1	92		48.1	51.6	83		10		75-125	20
Thallium	U	5.00	4.86	97		4.95	4.94	100		3		75-125	20
Vanadium	17.7	49.5	63.6	93		48.1	61.5	91		2		75-125	20
Zinc	1627	49.5	1039	NC		48.1	936	NC		NC		75-125	20

Table 2.6 (cont.) Results of the MS/MSD Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results based on as received weight

Sample ID: B03616

Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec	MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec	RPD	Recommended QC Limits %Rec	Recommended QC Limits RPD
Antimony	136	49.0	195	120	48.1	154	37 *	105 *	75-125	20
Arsenic-ICAP	1199	49.0	1218	NC	48.1	1171	NC	NC	75-125	20
Barium	458	49.0	449	NC	48.1	426	NC	NC	75-125	20
Beryllium	1	49.0	49.6	99	48.1	48.8	99	0	75-125	20
Cadmium	36.4	49.0	77.6	84	48.1	77	84	0	75-125	20
Chromium	3.7	49.0	51.2	97	48.1	50.3	97	0	75-125	20
Cobalt	5.38	49.0	50.1	91	48.1	51.4	96	5	75-125	20
Copper	890	49.0	945	NC	48.1	1314	NC	NC	75-125	20
Lead	5211	49.0	10520	NC	48.1	5211	NC	NC	75-125	20
Manganese	284	49.0	292	NC	48.1	343	NC	NC	75-125	20
Mercury	4.21	0.351	4.39	NC	0.364	4.45	NC	NC	75-125	20
Nickel	10.9	49.0	55.8	92	48.1	56.8	95	4	75-125	20
Selenium	6.36	4.95	7.38	21 *	4.85	6.99	13 *	47 *	75-125	20
Silver	25.5	49.0	79.3	110	48.1	65.9	84	27 *	75-125	20
Thallium	U	4.95	4.57	92	4.85	4.25	88	5	75-125	20
Vanadium	5.24	49.0	51.1	94	48.1	50.1	93	0	75-125	20
Zinc	4373	49.0	4034	NC	48.1	4376	NC	NC	75-125	20

Table 2.6 (cont.) Results of the MS/MSD Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site
Results based on as received weight

Sample ID:	B03625										
Metal	Sample Conc mg/kg	MS Spike Added mg/kg	MS Conc mg/kg	MS % Rec		MSD Spike Added mg/kg	MSD Conc mg/kg	MSD % Rec		RPD		Recommended QC Limits %Rec	RPD
Antimony	U	48.5	11	23	*	49.0	13	27	*	16		75-125	20
Arsenic-ICAP	80.7	48.5	129	99		49.0	119	78		24	*	75-125	20
Barium	45.4	48.5	105	123		49.0	102	115		6		75-125	20
Beryllium	U	48.5	50.1	103		49.0	48.7	99		4		75-125	20
Cadmium	U	48.5	45.6	94		49.0	42.7	87		8		75-125	20
Chromium	1.38	48.5	50.3	101		49.0	48.5	96		5		75-125	20
Cobalt	U	48.5	47	97		49.0	45.7	93		4		75-125	20
Copper	37	48.5	84.1	96		49.0	82.4	92		5		75-125	20
Lead	927	48.5	906	NC		49.0	3294	NC		NC		75-125	20
Manganese	14	48.5	62.5	100		49.0	60.2	94		6		75-125	20
Mercury	0.303	0.455	0.795	108		0.488	0.837	109		1		75-125	20
Nickel	U	48.5	47.5	98		49.0	45.9	94		4		75-125	20
Selenium	U	4.95	4.26	86		4.90	4.51	92		7		75-125	20
Silver	U	48.5	43.5	90		49.0	40.8	83		7		75-125	20
Thallium	U	4.95	4.61	93		4.90	4.58	93		0		75-125	20
Vanadium	U	48.5	46.2	95		49.0	44.7	91		4		75-125	20
Zinc	46.2	48.5	351	632	*	49.0	92.3	94		148	*	75-125	20

Table 2.7 Results of the Blank Spike Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site

Metal	Spiked Conc. mg/kg	Blank Conc. mg/kg	Rec Conc. mg/kg	% Recovery	Recommended QC Limits %Rec
Aluminum	400	U	448	112	75-125
Antimony	50.0	U	48.3	97	75-125
Arsenic	50.0	U	49.1	98	75-125
Barium	50.0	U	49.1	98	75-125
Beryllium	50.0	U	50.4	101	75-125
Cadmium	50.0	U	46.7	93	75-125
Calcium	400	U	383	96	75-125
Chromium	50.0	U	49.4	99	75-125
Cobalt	50.0	U	49.5	99	75-125
Copper	50.0	U	49	98	75-125
Iron	400	U	408	102	75-125
Lead	50.0	U	48.8	98	75-125
Magnesium	400	U	384	96	75-125
Manganese	50.0	U	48.8	98	75-125
Mercury	0.392	U	0.4	102	75-125
Nickel	50.0	U	50.3	101	75-125
Potassium	800	U	711	89	75-125
Selenium	4.95	U	4.99	101	75-125
Silver	50.0	U	46.4	93	75-125
Sodium	400	U	387	97	75-125
Thallium	4.95	U	5.15	104	75-125
Vanadium	50.0	U	48.6	97	75-125
Zinc	50.0	U	48	96	75-125

Table 2.7 (cont.) Results of the Blank Spike Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site

Metal	Spiked Conc. mg/kg	Blank Conc. mg/kg	Rec Conc. mg/kg	% Recovery	Recommended QC Limits %Rec
Aluminum	400	U	421	105	75-125
Antimony	50.0	U	44.7	89	75-125
Arsenic-ICAP	50.0	U	47	94	75-125
Barium	50.0	U	47.7	95	75-125
Beryllium	50.0	U	49.9	100	75-125
Cadmium	50.0	U	45.4	91	75-125
Calcium	400	U	376	94	75-125
Chromium	50.0	U	48.3	97	75-125
Cobalt	50.0	U	48.3	97	75-125
Copper	50.0	U	48.1	96	75-125
Iron	400	U	396	99	75-125
Lead	50.0	U	45	90	75-125
Magnesium	400	U	372	93	75-125
Manganese	50.0	U	47.9	96	75-125
Mercury	0.400	U	0.4	100	75-125
Nickel	50.0	U	49	98	75-125
Potassium	800	U	689	86	75-125
Selenium	5.00	U	5.03	101	75-125
Silver	50.0	U	45.1	90	75-125
Sodium	400	U	378	95	75-125
Thallium	5.00	U	5.31	106	75-125
Vanadium	50.0	U	47.4	95	75-125
Zinc	50.0	U	46.7	93	75-125

Table 2.8 Results of the LCS Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	LCS Standard (ERA Lot#)	Conc. Rec µg/L	Certified Value µg/L	PALs µg/L	% Rec
Aluminum	10/18/01	LCS 248	8722	9200	5300 - 13100	95
Antimony	10/18/01	LCS 248	26	62.7	17.1 - 141	41
Arsenic	10/18/01	LCS 248	51	47.5	34.4 - 60.6	107
Barium	10/18/01	LCS 248	505	509	392 - 626	99
Beryllium	10/18/01	LCS 248	59.9	55.9	43.8 - 68.2	107
Calcium	10/18/01	LCS 248	11794	11700	8740 - 14600	101
Cadmium	10/18/01	LCS 248	162	157	118 - 196	103
Chromium	10/18/01	LCS 248	51.4	51.4	39.0 - 63.7	100
Cobalt	10/18/01	LCS 248	91	88.4	68.8 - 108	103
Copper	10/18/01	LCS 248	71.3	69.5	56.9 - 82.0	103
Iron	10/18/01	LCS 248	13020	13700	8350 - 19100	95
Lead	10/18/01	LCS 248	184	186	139 - 233	99
Magnesium	10/18/01	LCS 248	3041	3070	2280 - 3860	99
Manganese	10/18/01	LCS 248	679	674	511 - 836	101
Mercury	10/10/01	LCS 248	6.42	6.21	4.19 - 8.23	103
Nickel	10/18/01	LCS 248	117	112	87.6 - 137	104
Potassium	10/18/01	LCS 248	3306	3640	2670 - 4610	91
Selenium	10/24/01	LCS 248	115	107	66.3 - 148	107
Silver	10/18/01	LCS 248	85.6	84.3	54.2 - 114	102
Sodium	10/18/01	LCS 248	807	863	585 - 1140	94
Thallium	10/24/01	LCS 248	67.5	68.1	39.0 - 97.4	99
Vanadium	10/18/01	LCS 248	134	136	92.6 - 179	99
Zinc	10/18/01	LCS 248	288	289	224 - 356	100

Table 2.8 (cont.) Results of the LCS Analysis for Metals in Soil
WA # 0-232 Yankee Mine Site

Metal	Date Analyzed	LCS Standard (ERA Lot#)	Conc. Rec µg/L	Certified Value µg/L	PALs µg/L	% Rec
Aluminum	10/17/01	LCS 248	7821	9200	5300 - 13100	85
Antimony	10/17/01	LCS 248	25.1	62.7	17.1 - 141	40
Arsenic-ICAF	10/17/01	LCS 248	47.5	47.5	34.4 - 60.6	100
Barium	10/17/01	LCS 248	486	509	392 - 626	95
Beryllium	10/17/01	LCS 248	60.4	55.9	43.8 - 68.2	108
Calcium	10/17/01	LCS 248	12059	11700	8740 - 14600	103
Cadmium	10/17/01	LCS 248	163	157	118 - 196	104
Chromium	10/17/01	LCS 248	51.3	51.4	39.0 - 63.7	100
Cobalt	10/17/01	LCS 248	90.7	88.4	68.8 - 108	103
Copper	10/17/01	LCS 248	72.8	69.5	56.9 - 82.0	105
Iron	10/17/01	LCS 248	12703	13700	8350 - 19100	93
Lead	10/17/01	LCS 248	192	186	139 - 233	103
Magnesium	10/17/01	LCS 248	2944	3070	2280 - 3860	96
Manganese	10/17/01	LCS 248	689	674	511 - 836	102
Mercury	10/12/01	LCS 248	5.93	6.21	4.19 - 8.23	95
Nickel	10/17/01	LCS 248	117	112	87.6 - 137	104
Potassium	10/17/01	LCS 248	3146	3640	2670 - 4610	86
Selenium	10/23/01	LCS 248	115	107	66.3 - 148	107
Silver	10/17/01	LCS 248	85	84.3	54.2 - 114	101
Sodium	10/17/01	LCS 248	776	863	585 - 1140	90
Thallium	10/23/01	LCS 248	72.3	66.1	39.0 - 97.4	106
Vanadium	10/17/01	LCS 248	131	136	92.6 - 179	96
Zinc	10/17/01	LCS 248	293	289	224 - 356	101

REAC, Edison, NJ
(732) 321-4200
EPA Contract 68-C99-223

CHAIN OF CUSTODY RECORD

Project Name: Yanfee Mine Site
Project Number: RIA00232
LM Contact: BROWMAN Phone: (732) 321-4230

No: 00537
Sheet 01 of 01 (Do not copy)
(for addnl. samples use new form)

10 cyclr

Sample Identification | **Analyses Requested**

REAC#	Sample No	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	TAL METALS
992	B03620	54 DUP	S	2 OCT 2001	1	XRF CUP /4°C	✓
993	B03621	59		3 OCT 2001			
994	B03622	61					
995	B03623	64					
996	B03624	75					
997	B03625	86 *					
998	B03626	97		4 OCT 2001			
999	B03627	9-2'		3 OCT 2001			
000	B03628	9-4'					

Matrix:

A- Air
AT-Animal Tissue
DL- Drum Liquids
DS- Drum Solids
GW- Groundwater
O- Oil
PR-Product
PT-Plant Tissue
PW- Potable Water
S- Soil
SD- Sediment
SL- Sludge
SW- Surface Water
TX-TCLP Extract
W- Water
X- Other

QA/QC.

Special Instructions:

* MS/MSD

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #:

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished by	Date	Received by	Date	Time
ALL/ANALYSIS		10-1-01		10-9-01	0900	all/TAL		10-9-01	C Nasser	10/9/01	16:10

REAC, Edison, NJ
(732) 321-4200
EPA Contract 68-C99-223

CHAIN OF CUSTODY RECORD

Project Name: Yuntee Mine Site
Project Number: RIA0832
LM Contact: GROSSMAN Phone: (732) 321-4230

No: 00536
Sheet 01 of 01 (Do not copy)
(for addnl. samples use new form)

10990i—

Sample Identification

Analyses Requested

REAC#	Sample No	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	TAL METALS
973	B03601	2	S	1 OCT 2001	1	4RF CUP / 4°C	✓
974	B03602	4					
975	B03603	7					
976	B03604	10					
977	B03605	10 DUP					
978	B03606	12					
979	B03607 *	14					
980	B03608	18					
981	B03609	20					
982	B03610	23		2 OCT 2001			
983	B03611	23 DUP					
984	B03612	25					
985	B03613	28					
986	B03614	29					
987	B03615	32					
988	B03616	35					
989	B03617	44					
990	B03618	50					
991	B03619	54					

Matrix:

A- Air	PW- Potable Water
AT-Animal Tissue	S- Soil
DL- Drum Liquids	SD- Sediment
DS- Drum Solids	SL- Sludge
GW- Groundwater	SW- Surface Water
O- Oil	TX-TCLP Extract
PR-Product	W- Water
PT-Plant Tissue	X- Other

QA/QC:

Special Instructions:

* MS/MSD

9-7-6 open and split-spn

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #:

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished by	Date	Received by	Date	Time
ALL/ANALYSIS	[signature]	10/4/01	[signature]	10-9-01	0900	ALL/TAL	[signature]	10-9-01	C Bassen	10/9/01	16:10

REAC, Edison, NJ
(732) 321-4200
EPA Contract 68-C99-223

CHAIN OF CUSTODY RECORD

Project Name: Yankee Mine Site
Project Number: R1A00232
LM Contact: GOSSMAN Phone: (732) 321-4230

No: 00358
Sheet 01 of 01 (Do not copy)
(for addnl. samples use new form)

106901—

Sample Identification

Analyses Requested

REAC#	Sample No	Sampling Location	Matrix	Date Collected	# of Bottles	Container/Preservative	TAL METALS
957	~~A04450~~ A04451	SW-01	W	30CT2001	1	1L Poly / 4°C HNO3 pH<2	✓
958	A04452	SW-01 DUP					
959	A04453	SW-02					
960	A04454	SW-03					
961	A04455	SW-04					
962	A04456	SW-05					
963	A04457	SW-06					
964	A04458	SW-07					
965	A04459	SW-08					
966	A04460	SW-09					
967	A04461	SW-10					
968	A04462	SW-11					
969	A04463	SW-12					
970	A04464	SEEP 1					
971	A04465	SEEP 2					
972	A04466	FIELD BLANK	↓	↓	3	↓	↓

Matrix:

A- Air	PW- Potable Water
AT-Animal Tissue	S- Soil
DL- Drum Liquids	SD- Sediment
DS- Drum Solids	SL- Sludge
GW- Groundwater	SW- Surface Water
O- Oil	TX-TCLP Extract
PR-Product	W- Water
PT-Plant Tissue	X- Other

Special Instructions:

(5) QA/QC:
* ~~MS/MSD~~

SAMPLES TRANSFERRED FROM CHAIN OF CUSTODY #:

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished by	Date	Received by	Date	Time
ALL ANALYSIS		10/4/01		10-9-01	0900	all analysis		10-9-01	C Bassen	10/9/01	15:50